U.S. Department
of Transportation
**Federal Aviation
Administration**

# Advisory Circular

**AC 120-29A**

**Draft 23 - December 7, 1999**

# CRITERIA FOR APPROVAL OF CATEGORY I AND CATEGORY II WEATHER MINIMA FOR APPROACH

**1. Purpose.** This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of operations in Category I and II Landing Weather Minima including the installation and approval of associated aircraft systems. It includes additional Category I and II criteria or revised Category I and II criteria for use in conjunction with RNAV, Required Navigation Performance (RNP), VNAV, xLS, satellite navigation systems (GLS), Head-up Displays, and Category II during certain engine inoperative operations. This revision also updates and incorporates provisions of the former AC 120-29 through Change 3 into the revised AC 120-29A.

This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the Federal Aviation Administration (FAA), European Joint Aviation Authorities (JAA), and several other regulatory authorities. Subsequent revisions of this AC are planned as additional all weather operations harmonization items (AHI) are agreed and completed by FAA JAA, and other regulatory authorities.

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## (RESERVED)

**1. PURPOSE.** This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of Category I and II Weather Minima including the installation and approval of associated aircraft systems. This AC is applicable to Title 14 of the Code of Federal Regulations (14 CFR) parts 121, 135, and those part 125 operators not exempted under section 125.1 or not having received an applicable deviation authorization under Section 125.3. Certain aspects of this AC are applicable to 14 CFR part 129 operators. Many of the principles, concepts and procedures described also may apply to 14 CFR part 91 operations and are recommended for use by those operators when applicable. Mandatory terms used in this AC as shall or must are used only in the sense of insuring applicability of these particular methods of compliance when the acceptable means of compliance described herein is used. This AC does not change, add or delete regulatory requirements or authorize deviations from regulatory requirements.

Major changes introduced in this revision include new provisions for RNP, VNAV, FMS, GNSS, HUD, GLS, revised obstacle assessment criteria related to RNP, and revised airborne equipment requirements for Category I and II.

With issuance of AC120-29A, the former AC 120-29, dated December 3, 1974, is canceled.

**2. RELATED REFERENCES AND DEFINITIONS.**

**2.1. Related References.**

14 CFR part 91, sections 91.175, and 91.189; 14 CFR part 121, sections 121.579, and 121.651; 14 CFR part 125, sections 125.379, and 125.381; 14 CFR part 129, section 129.11; and 14 CFR part 135, section 135.225.

Current editions of the following Advisory Circulars: AC120-28, AC20-129; AC20-130; AC25-15

Standard Operations Specifications (OpSpecs) Part A and C and FAA Orders 8400.8, 8400.10, and 8400.13

JAA ACJ AWO 231, *[Ed Note: Date of Current Version - to be supplied by JRA or GB]*

**2.2. Definitions.** A comprehensive set of definitions pertinent to Category I and II is included in Appendix I.

**3. BACKGROUND.**

**3.1. Major Changes Addressed in this Revision.** This circular includes additional Category I and Category II criteria or revised Category II criteria for use of Head-up Displays, use of Required Navigation Performance (RNP), satellite navigation sensors, and "engine inoperative" Category II. This revision expands information regarding Category I approach procedures, and now includes material pertinent to other types of approach procedures than ILS, MLS or GLS (e.g., also addresses approaches previously considered as non-precision approaches).

This circular also clarifies existing criteria to address frequently asked questions.

This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the FAA, European JAA, and several other regulatory authorities. Subsequent revisions of this AC are planned as additional all weather operations harmonization items (AHI(s)) are agreed and completed by FAA and JAA, or internationally.

**3.2. Relationship of Operational Authorizations for Category I or Category II and Airborne System Demonstrations.** Approach weather minima are approved through applicable operating rules, use of approved instrument procedures and issuance of Operations Specifications (Op-Specs)*. Airworthiness demonstration of aircraft equipment is usually accomplished in support of operational authorizations on a one time basis at the time of Type Certification (TC) or Supplemental Type Certification (STC). This demonstration is based upon the airworthiness criteria in place at that time. Since operating rules continuously apply over time and may change after airworthiness demonstrations are conducted, or may be updated consistent with safety experience, additional Category I or Category II credit or constraints may apply to operators or aircraft as necessary for safe operations. In general, criteria related to operational approval is contained in the main body of

this AC and criteria related primarily to the airworthiness demonstration of systems or equipment is included in the appendices to this AC.

*NOTE: Operations Specifications are unique Federal Aviation Regulations applicable to a particular operator. Op-Specs are based on the FARs, however they are specifically applicable to and tailored to a particular operator's aircraft, routes, and operating circumstances. Standard Operations Specifications are developed by FAA and provided to FAA field offices to aid in development and issuance of the particular and unique Op-Specs issued to each operator.

**3.3. Applicable Criteria.** AC 120-29, dated December 3, 1974, is canceled. Except as described below, new airworthiness demonstrations or operational authorizations should use the criteria of AC 120-29A. Airworthiness demonstrations may use equivalent JAA criteria where agreed by FAA through the FAA/JAA criteria harmonization process. Operators electing to comply with these revised criteria may receive additional credit when using the revised criteria. Aircraft manufacturers or modifiers may elect to demonstrate their aircraft using the revised criteria to seek credit for additional operations. Aircraft demonstrated using earlier criteria may continue to be approved for Category I or Category II operations in accordance with that earlier criteria. Aircraft or operators seeking additional credit provided for in this AC must, however, use the criteria of this AC for that credit.

**3.4 Category I, II and III Terminology.** Since 1985 FAA has referred to all approaches other than Category II or Category III as Category I, for purposes or regulatory authorization (e.g., Operations Specifications). Thus for consistency and continuity, all Category I approach procedures and operational authorizations are now addressed in this Advisory Circulars. In addition to typical Category I ILS, MLS and GLS procedures (e.g. procedures historically considered as precision approach), information about approaches other than ILS, MLS and GLS are now included (e.g., procedures historically considered as non-precision approach). The use of the term “non-precision” has been dropped within this AC to reduce confusion which exists with use of this term with current and future systems and authorizations, particularly with VNAV and RNAV, and with other approaches that may incorporate the use of barometric VNAV to provide a stabilized descent path to a runway.

Accordingly, Category I, II and III terminology used in this Advisory Circular is based on and is consistent with current U.S. Standard Operations Specifications for FAR 121, 135 and 129 Operators. Definition usage is also consistent with other Advisory Circulars (e.g., AC120-28D). Definitions of instrument approach Categories in current U.S. use are listed in Appendix 1 of this circular (i.e., Category I, Category II, Category IIIa, IIIb, and IIIc). While there are slight variations of these definitions as used within ICAO and various countries internationally, the broad objectives and practical operational applications are similar. It is significant to note that for U.S. applications, Category I is considered to include any instrument approach procedure having minima not less than 200'HAT and RVR not less than 1800ft. Accordingly approaches such as LOC, LOC BCRS, LDA, SDF, VOR, NDB, RNAV are each considered to be Category I approaches. While in other states, Category I may only apply to straight-in ILS or MLS instrument procedures. Also, in certain other states, lowest authorized minima may be slightly different than as promulgated by the U.S. or ICAO criteria. In a few states, these approach categories relate more closely to aircraft configuration or ILS facilities used, rather than directly landing minima (e.g., DA(H) and visibility or RVR).

## 4. OPERATIONAL CONCEPTS.

**4.1. Classification and Applicability of Minima.** Landing minima are generally classified by Category I, Category II and Category III. Definitions for Category I, II, and III are as specified by ICAO and individual states. For the U.S. these definitions are as included in Appendix 1 of this AC. CHDOs and operators should be aware that slight differences exist in definition and use of Category I, II, and III terminology in international operations. Operators should assure that any definition use differences do not adversely affect intended operations (see Section 3.4 above).

This AC addresses criteria for Category I and Category II instrument approach operations. AC 120-28 (as amended) addresses takeoff in low visibility conditions and Category III landing operations.

Landing minima are generally addressed by sections 91.175, 121.649, 121.651, 121.652 and standard or special OpSpecs Part C. Application of these definitions of Category I, II, and III to landing is discussed in section 4.3.1 below.

Although a wide variety of normal and non-normal situations are considered in the design and approval of systems and procedures for Category I and Category II, landing weather minima are primarily intended to apply to normal operations. For non-normal operations, flightcrews are expected to take the safest course of action appropriate for the situation, notwithstanding landing weather minima. When aircraft systems have been demonstrated to account for certain non-normal configurations and a procedure is specified (e.g., an approach with an engine inoperative non-normal procedure) flightcrew may take account of this information in assessing the safest course of action. In addition, when inoperative aircraft systems have been accounted for in the AFM as an alternate configuration using criteria of this AC (e.g., an approach with an engine inoperative is specified as a demonstrated configuration) operational credit for that configuration (alternate minima credit) may be authorized.

Takeoff minimums are generally addressed by section 91, 121, 135 and standard or special OpSpecs. Application of takeoff minima is discussed in section 4.2 below.

**4.2. Takeoff.**

**a. Takeoff Minima.** Takeoff minima are addressed by sections 91.175(f), 121.649, 121.651, 135.225, and standard or special OpSpecs Part C. The authority for lower than standard takeoff minimums is contained in Sections 135.225(h)(3) and 121.651(a)(1).

Operations Specifications are applicable to part 121 and 135 operators and certain other operators (e.g., part 125 and part 129). Where minima lower than that provided in standard OpSpecs are necessary, applicable criteria for use of those minima are specified in AC 120-28D. When appropriate, principal operations inspectors (POI(s)) issue OpSpecs specifying the lower minima through paragraph C056 for part 121 operators and OpSpecs paragraph C057 for Part 135 operators. OpSpecs contain specific guidance regarding pilots, aircraft, and airports when lower than standard takeoff minimums are used.

**b. Visibility Assessment and RVR Equivalence for Takeoff.**

**1) Determining equivalent meteorological visibility minima when takeoff minima are expressed only in terms of RVR.** For takeoff procedures where minima are expressed only in terms of RVR, but visibility is being reported as a meteorological visibility, the "visibility-RVR" equivalence table referenced in Standard OpSpecs may be used to establish equivalent RVR (see Appendix 7, OpSpec Paragraph C051).

**2) Determining equivalent RVR minima when takeoff minima are expressed only in terms of meteorological visibility.** For takeoff procedures where minima are expressed in terms of meteorological visibility, but reported visibility available to the pilot is specified in terms of RVR, the "Visibility-RVR Equivalence" table referenced in Standard OpSpecs (see Appendix 7) may not be used to establish equivalent minima.

**3) Pilot Assessment of equivalent RVR.** For takeoff circumstances where Touchdown Zone RVR is inoperative or is determined by the pilot to be significantly in error (e.g., patchy fog obscuring a transmissometer but not the runway, snow on transmissometer causing erroneous readings) a pilot assessment may be made in lieu of RVR (see Appendix 7, OpSpec Paragraph C056).

To be eligible to use this provision the operator must assure that each pilot authorized to make this determination has completed approved training addressing pilot procedures to be used for visibility assessment in lieu of RVR, and the pilot can determine the necessary runway markings or runway lighting that must be available to provide an equivalent RVR to that specified to assure adequate visual reference for the takeoff.

When any pilot assessment of equivalent RVR is made, the pilot must be able to positively determine position on the airport and correct runway, and positively establish that the aircraft is at the correct position for initiation of takeoff. Typically this equivalent RVR assessment is applicable only at a runway threshold where runway identifying markings and number(s) are visible from the takeoff position (e.g., not applicable to intersection takeoffs).

When such a pilot RVR assessment is made, the result of the assessment should typically be provided to any pertinent air traffic facility when practical, and may also be provided to the operator (e.g., dispatch) to facilitate other operations.

**4.3. Landing.**

**4.3.1. Approach and Landing Concepts and Objectives.** Landing minima are classified as Category I, Category II, and Category III. Definitions of these categories are provided in Standard OpSpecs Part A paragraph A2, and in Appendix 1 of this AC. While generally consistent with ICAO definitions, the definitions used in Standard OpSpecs, where different from ICAO, apply and take precedence for United States (U.S.) Operators, or for international operators conducting operations within the U.S., or at U.S. facilities.

For U.S. operators, any instrument approach with a DA(H) or MDA(H) and visibility above that specified in OpSpecs for Category I, (see Appendix 7) is considered to be a Category I operation (e.g., an approach with either a DA(H) or an MDA(H) which is not lower than 200' HAT and visibility not less than 1800 RVR is considered to be Category I, even though it may be based on a NAVAID other than ILS).

Any instrument approach with a DA(H) or visibility less than that specified for Category I, but above that specified in for Category II, is considered to be a Category II operation.

Any instrument approach with a DA(H) less than that specified for Category II (or with no DA(H) or with an Alert Height), or with a visibility less than that specified for Category II, in accordance with applicable OpSpecs is considered to be a Category III operation.

Category I operations may be conducted manually using raw data information, by reference to flight guidance displays (flight directors), or automatically using approved autopilot or autoland systems. However, air carrier operations, particularly with turbine powered aircraft, typically have minima restricted by operations specifications if a flight director or autopilot is not used.

For Category I, basic airworthiness certification for IFR under provisions of 14 CFR part 25 typically is considered an acceptable means of demonstration of capability for operational acceptance of an aircraft and its associated systems. Specific criteria for airworthiness demonstration of certain specific systems or capabilities for Category I are included in Appendix 2 (e.g., FMS or RNP).

For Category I minima, it is expected that for non-normal operations (e.g., engine(s) inoperative, hydraulic or electrical system(s) failure) the pilot or operator should consider any necessary adjustment of operating minima, wind limit constraints, or other factors to assure safe operation with the non-normal condition.

Category II operations may be conducted manually using flight guidance (e.g., flight director) displays. However, most Category II operations are conducted using an autopilot or autoland system, or with combinations of systems using both

automatic and flight guidance (e.g., flight director) elements. Additional demonstration or operational assessment beyond that required for basic IFR flight under provisions of basic aircraft 14 CFR part 25 type certification typically is necessary for operational authorization of an aircraft for Category II (see Section 5 and Appendix 3). Specific criteria for airworthiness demonstration of systems or capabilities for Category II are included in Appendix 3 (e.g., for flight director(s), autopilot(s), or HUD) for cases where an applicant seeks prior credit for such an airworthiness demonstration in the airplane flight manual (AFM).

For Category II minima, certain non-normal conditions are typically considered in the assessment and authorization process. Response to those non-normal conditions may be explicitly defined in the Category II authorization (e.g., engine failure, electrical component failure, or engine inoperative Category II). For failures other than those addressed by the Category II authorization, the pilot or operator may need to adjust the operating minima used, introduce wind limit constraints, or address other factors to assure safe operation for the particular non-normal condition.

**4.3.1.1. Operational Safety Evaluation.** For any instrument approach, using either Category I or Category II minima, the operator must adequately consider and provide for safe operations considering at least the following:

1) The possibility of a failure of any one of the pertinent navigation system, flight guidance system, flight instrument system, or annunciation system elements used for the approach or missed approach (e.g., ILS receiver failure, Autopilot disconnect, etc.),

2) The possibility of a failure of a key aircraft component or related supporting system during the approach or missed approach (e.g., engine failure, electrical generator failure, single hydraulic component failure). Even though a particular failure may in itself be considered to remote based on exposure time (e.g., engine failure), it is nonetheless important to address these considerations since, in practical circumstances, a "go-around" may be due to a factor which relates to or leads to the failure, and thus is not an independent event (e.g., flocking bird ingestion). This is consistent with the long standing principle of safety of operation of multi-engine aircraft in air carrier operations which notes that after passing V1 on takeoff, until touchdown, the aircraft should typically be able to sustain a failure such as engine failure and still safely be able to continue flight and land.

3) The possibility of a balked landing or rejected landing at or below DA(H), or MDA(H), as applicable,

4) The possibility of loss or significant reduction of visual reference, that may result in or require a go-around,

5) Suitable obstacle clearance following a missed approach, considering applicable aircraft configuration during approach and any configuration changes associated with a go-around (e.g., engine failure, flap retraction).

6) For special airports identified in accordance with section 121.445 (e.g., mountainous terrain), or other airports with critical obstacles that have not otherwise been accounted for, the ability to assure suitable obstacle clearance following a rejected landing; applicable aircraft configuration(s) during approach and any configuration changes associated with a go-around and missed approach should be considered.

7) Unusual atmospheric or environmental conditions that could adversely affect the safety of the operation (e.g., extreme cold temperatures, known local atmospheric or weather phenomena that introduce undue risk, etc.).

When conducting a safety assessment of issues listed above, and uncertainty exists as to aircraft failure condition effects, procedural design intent or margins, aircraft characteristics or capabilities following failure, or other such issues, the operator should consult with an appropriate organization source able to provide reliable and comprehensive information. Typically this includes consultation with one or more of the following as applicable, and as necessary:

- Aircraft manufacturer,
- Avionics manufacturer;
- Procedure designer;
- Air Traffic Service provider, or regulatory authority.

NOTE: For definitions and discussion of differences among the terms "balked landing", "rejected landing", "go-around", and "missed approach", see Appendix 1.

**4.3.1.2. Primary and Supplementary Means of Navigation and Required Navigation Performance (RNP).**

"Primary" and "Supplementary" means of navigation and Required Navigation Performance (RNP) are as defined in Appendix 1. Application of these terms to instrument approach or takeoff are as described below. In addition, it should be noted that the term "Primary Means of Navigation" may apply to either instrument approach initial, intermediate final approach or missed approach courses of procedures flown to Category I or Category II minima. The term Supplemental Means of Navigation can typically apply to initial or intermediate segments or Missed approach segments, but typically does not apply to flying a final approach course of an instrument procedure. For definitions of Category I or Category II as used by the US and ICAO, see Appendix 1.

**a. Primary Means of Navigation.** A "Primary Means" of navigation is a means of navigation that satisfies each of the necessary levels of accuracy and integrity for a particular area, route, procedure or operation. The failure of a "Primary Means" of navigation may result in, or require reversion to a "non-normal" means of navigation or alternate level of RNP.

"Availability" as relates to a primary means of navigation is typically addressed in conjunction with the applicable operating rules for use of the system, in the context of the area, airspace, route, procedures or operations for which system use is intended (e.g., use of multiple versus single sensors or systems, or navaid signal access, reliability, or continuity of service as might apply to a particular approach path).

As applicable to instrument approach operations for an air carrier, particularly for a final approach segment or a missed approach segment, the following may be considered to satisfy requirements for a primary means of navigation.

For sensor specific approaches (e.g., VOR, or NDB, or ILS) each particular airborne system using its respective associated NAVAID (e.g., ILS) may be considered as the "primary means of navigation" for completion of that respective specified approach procedure (e.g., ILS RWY 16R).

When multiple components are required (e.g., ILS, with use of an NDB for the missed approach), the collective set of specified navigation components are considered to be the primary means of navigation for that procedure. Failure of any one of the required components may preclude use of the procedure, or may require reversion to a non-normal means of navigation for completion of the procedure (e.g., failure of the NDB missed approach NAVAID associated with an ILS approach).

For RNAV based procedures where the only method of flying the procedure is by an RNAV or RNAV/RNP system (e.g., FMS), RNAV is considered to be the primary means of navigation for that approach procedure. Any associated NAVAID, or combinations of NAVAIDs, or airborne sensors necessary to achieve the necessary level of FMS performance may be considered as an input sensor(s) to the FMS, but the sensors or NAVAIDs taken alone are not necessarily considered to be the primary means of navigation.

Where RNAV systems are used to overfly other types of instrument approach procedures (e.g., FMS RNAV systems overflying flying VOR or NDB procedures), the RNAV system may be considered as a supplemental system if the aircraft can revert to use of the underlying procedure flown with "raw data", in the event of failure of the RNAV system (see b. below).

**b. Supplementary Means of Navigation.** A "Supplementary Means" of navigation is a means of navigation which satisfies one or more, but not necessarily all of the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure or operation. The failure of a "Supplementary Means" of navigation may result in, or require reversion to another alternate "normal" means of navigation for the intended route, procedure or operation.

As applicable to instrument approach operations for an air carrier, particularly for a final approach segment or a missed approach segment, the following may be considered to satisfy requirements as a supplementary means of navigation.

When procedures have multiple methods to achieve compliance (e.g., a multi-sensor FMS overflying a VOR approach, or an ILS approach with the choice of either an NDB or a VOR based missed approach), those airborne systems which have another alternate normal means to accomplish the procedure, or a portion of the procedure, for one or more applicable segments, may be considered as supplementary for those applicable segments (e.g., if the FMS should fail, and the crew is monitoring the underlying VOR information, and the crew can transition to use of VOR based navigation) the FMS may be considered as supplementary.

Or, if after an ILS approach, FMS RNAV capability is used to overfly a VOR/DME based missed approach (with VOR/ DME NAVAID facilities operating), the FMS RNAV capability may be considered supplementary. Note however, that if the specified approach/missed approach VOR/DME NAVAIDs are not operative, and the FMS RNAV operation is based on use of multi-sensor NAVAID capability, then the FMS use for that approach/missed approach would typically considered a primary means of navigation.

**c. Required Navigation Performance (RNP).** Required Navigation Performance is a statement of the navigation performance necessary for operation within a defined airspace (Adapted from ICAO - IS&RP Annex 6). Required Navigation Performance is specified in terms of accuracy, integrity, and availability of navigation signals and equipment for a particular airspace, route, procedure or operation.

**4.3.1.3. Use of ICAO Standard NAVAIDs.** U.S. Category I or Category II Operations are based on use of ICAO standard NAVAIDs, equivalent NAVAIDs, or other NAVAIDs acceptable to FAA and approved in OpSpecs. Authorization for use of NAVAIDs other than ICAO Standard NAVAIDs must be coordinated with AFS-400.

In the context of this AC, a Standard Landing Aid (SLA) is considered to be any navigation service or navigation aid provided by a State which meets internationally accepted performance standards (e.g., ICAO Standards and Recommended Practices (SARPs), or equivalent U.S. or other State standards - see Appendix 1).

**4.3.1.4. Standard Instrument Approach Procedures (SIAPS).**

**a. Acceptable Instrument Approach Procedure Basis.**
Instrument approach procedures used by operators in accordance with this AC should be based on:

1) U.S. Standard Instrument Approach Procedures,

2) For non-U.S. airports, foreign instrument approach procedures acceptable to FAA promulgated by the state of the airport of landing (i.e. ICAO - State of the Aerodrome). The operator may propose use of such procedures for POI, APM or CMO acceptance,

3) Military instrument procedures acceptable to FAA for operations at military facilities. The operator may propose use of such procedures for POI, APM or CMO acceptance,

4) Special instrument approach procedures developed by the FAA,

5) Special instrument approach procedures developed by the operator which are acceptable to FAA, or procedures developed by the operator using methods acceptable to FAA, or

6) Special instrument approach procedures, acceptable to FAA, developed by other U.S. or non-U.S. operators, or by the State of the Aerodrome (for foreign airports).

**b. Considerations for use of procedures other than U.S. Standard procedures.**
For procedures other than those developed in accordance with FAA Order 8260.3 Standards for Terminal Instrument Procedures (as amended), the operator must assure consideration of at least the following factors related to use of those instrument procedures:

1) Availability of suitable weather reporting and forecasts,

2) Identification of any necessary alternates airports or alternate minima,

3) Ability to discontinue an approach, if necessary, from any point to touchdown (extraction),

4) Suitability of the airborne equipment to use the procedure (e.g., compatibility of the airborne equipment with the type/characteristics of the ILS, VOR, DME, NDB ground facilities used),

5) Suitability of Ground Systems/Equipment (e.g., lighting, transmissometers, pilot control of lighting),

6) Suitability of NAVAIDs (e.g., maintenance, monitoring),

7) Suitability of Airport/Runway (e.g., obstructions, clear zones, markings),

8) Availability of Aeronautical Information (e.g., timely NOTAM availability),

9) Identification of any special Training or qualification related to the procedure, and

10) Resolution of any issues identified from adverse "service experience" with the procedure.

**c. Special Instrument Approach Procedures.**
Special instrument approach procedures other than those developed by FAA should be coordinated with the Flight Standards Division (e.g., flight procedures specialist) of the FAA region having responsibility for the airport of the procedure. Special procedures should address any provisions associated with application of section 121.445 for special airport qualification. Special procedures are approved by the POI after coordination with pertinent FAA organizations. Special procedures other than those based on criteria described in FAA Order 8260.3 as amended, Order 7100.11 as amended, or Order 8260.40 as amended, should be coordinated with AFS-400 prior to POI approval.

**d. Use of FAA/JAA Harmonized Instrument Approach Minima Tables**
Information from FAA/JAA harmonized instrument approach minima tables may be incorporated into the following instrument procedures (see Section 6.2.18 and Appendix 8):

1) Standard U.S. procedures, as otherwise specified by FAA Order 8260.3, as amended, or
2) Non-U.S. procedures used by U.S. operators when suitably incorporated into a foreign instrument approach procedure and when that procedure is found acceptable for use by the FAA, or
3) "Special" instrument approach procedures applicable to one or more operators.

**4.3.1.5. "Steep Approaches" and Approach Path Descent Angle Constraints.** Approach path angles between 2.75 degrees and 3.77 degrees are considered standard for air carrier operations. Approach angles above 3.77 degrees are considered "steep angle" and, if authorized, may require additional assessment. Air carrier use of approach angles over 3.77 degrees require coordination with AFS-400. Use of approach angles over 4.5 degrees should normally be based on an associated aircraft type AFM provision for "steep angle approaches", in accordance with FAA AC 25-7A as amended, or equivalent, and Appendix 2 section 6.8 of this Advisory Circular.

**4.3.1.6. "Normal Maneuvering" Considerations.** Section 91.175 requires that approach procedures should be based on use of "normal maneuvers" before and after passing DA(H) or MDA(H). Normal maneuvers typically do not involve use of bank angles greater than 30 degrees, pitch attitudes in excess of 25 degrees nose up or 10 degrees nose down, or sink rates in excess of 1100 feet per minute below 500 feet HAT while maneuvering to land within the touchdown zone, during go-around, or during a rejected landing. During a missed approach, pitch attitudes en excess of +30 degrees or bank angles greater than 30 degrees would typically be considered excessive.

**4.3.1.7. Non-Normal Events or Configurations.** Takeoff and landing weather minimums are intended for normal operations. When non-normal events occur, flightcrews are expected to take the safest course of action to assure safe completion of the flight. Using emergency authority, crews may deviate from rules or polices, to the extent necessary for the circumstances, to minimize risk during landing.

Section 6.1.8 addresses guidelines and procedures to be considered in conducting an instrument approach during a non-normal event.

**4.3.1.8. Go-Around Safety.**

**a. General.** A multiengine aircraft conducting a Category I or Category II instrument approach should be capable of safely executing a "one-engine-inoperative" go-around from any point in an approach prior to touchdown with the aircraft in a normal configuration, or specified non-normal configurations (e.g., engine out, if applicable). This is necessary to provide for go-around safety due to missed approaches or rejected landings due to a variety of circumstances such as:

- Unexpected environmental conditions (e.g., cross winds, turbulence),
- Aircraft related failures (e.g., gear unsafe),
- Air Traffic Service contingencies (e.g., RTO on a crossing runway),
- Loss of visual reference,
- When a pilot finds the runway surface unsuitable (e.g., clutter, flocking birds)
- When the runway is blocked (airport vehicles or exiting aircraft ahead not clear), or due to a go-around or missed approach due to any other reason.

This objective may be achieved by the operator providing information to flight crews on an appropriate lateral flight path to follow to enable the aircraft to safely operate to the runway, and out from the runway following a rejected landing. In the rare event that operation out of a runway may not be possible following a rejected landing, then provision of suitable information on a "commit point", or equivalent condition (e.g., limit weight, minimum speed, or suitable configuration) may instead be provided. The intent of providing information on safe go-around capability is to identify the best option or options for a safe lateral ground track and flight path to follow in the event that a missed approach, balked landing, rejected landing or go-around is necessary. It is not the intention of this provision to require or indicate the need for an analysis of each flight, or a dispatch assessment, or an individual flight landing weight assessment or limitation. Operators may make the judgment as to whether a review on a "per-flight" or specific condition basis may or may not be needed.

While coping with the go-around contingency situation is appropriate for any operation, it is particularly important for low visibility operations in which the pilot has minimum time to respond, and may have limited visual reference available to safely cope with the adverse condition (e.g., night and poor visibility). Further,
"Go-around" safety should be addressed regardless of when an engine failure may occur prior to landing. However, operators may elect to distinguish between procedures or expected crew response for engine failures occurring at various times during a flight as follows:

1) Engine failure occurring enroute or prior to passing a final approach fix or point,
2) Engine failure during a final approach segment, or
3) Engine failure after passing DA(H) or after descending below MDA(H) but prior to touchdown, or during a go-around or missed approach.

For engine failure occurring prior to final approach, in flight diversion planning should allow for the potential need for a missed approach or balked landing, and for the need to maintain subsequent suitable obstacle clearance (e.g., when making suitable FAR 121.161. 121.191 or 121.193 diversion choices). The pilot should consider any adjustment to minima, procedures or missed approach path that may be appropriate to facilitate safe obstacle clearance (e.g., following a suitable operator "T-Procedure" or Departure Procedure (DP)). This is particularly appropriate if U.S. TERPS or ICAO PANS-Ops specified instrument procedural gradients cannot be met during any portion of a go-around or missed approach, or if following a suitable lateral path cannot be assured (e.g., crosswinds with no course guidance available, cannot maintain VMC, or at night).

For engine failure during approach, if there is any doubt of the ability to safely complete the landing or assure a safe balked landing and missed approach capability, the pilot should consider the advisability of discontinuing the approach and diverting to a different airport or runway, to better assure safe missed approach or balked landing obstacle clearance.

For engine failure after passing DA(H) or descending below MDA(H), the pilot should be prepared to expeditiously follow or join any pre-established and applicable "T-procedure" or "IFR Departure Procedure", or equivalent, until becoming established on a published segment of the missed approach procedure, at or above a safe altitude.

Accordingly, an operator should have reviewed the missed approach and rejected landing flight path to assure that in the event of a go-around the aircraft is able to assure safe obstacle clearance following a missed approach or go-around. This can be

particularly important in mountainous areas where the landing runway may be in a direction not typically used for takeoff (e.g., an airport that is one way in, and the opposite direction out).

**b. Go-Around Assessment Considerations.**

Operators may accomplish such assessments generically for a particular runway, procedure, aircraft type, and expected performance, and need not perform this assessment for each specific flight. Operators may use simplifying assumptions to account for the transition, reconfiguration, and acceleration distances following go-around (e.g., use expected landing weights, assume anticipated landing flap settings).

The operational considerations should include:

1) Go-around configuration transitions from approach to missed approach configuration including expected flap settings and flap retraction procedures,
2) Expected speed changes,
3) Appropriate engine failure and shutdown (feathering if applicable) provisions, if the approach was assumed to be initiated with all engines operative
4) Any lateral differences of the missed approach flight path from the corresponding takeoff flight path, and
5) Suitable balked landing obstacle clearance, until reaching instrument approach missed approach or enroute procedurally protected airspace.
6) Any performance or gradient loss during turning flight, if necessary to follow a flight path that is not over the runway or is not aligned with the runway after the balked landing transition,
7) Any relevant related situations such as if the aircraft cannot dump fuel and may need to make an emergency return landing above maximum landing weight immediately after takeoff.
8) Methods used for takeoff analysis, such as "Overspeed V2", "engine-out maximum angle climb", or other such techniques may be used if determined to be appropriate by the operator or aircraft manufacturer.
9) Applicable flight guidance system operational procedures used. Information about any techniques required to achieve the specified performance should be available to the flight crew (e.g., appropriate mode selection),
10) Operators may make obstacle clearance assumptions similar to those applied to corresponding takeoff flight paths (e.g. FAR 121.189) in the determination of net vertical flight path clearance or lateral track definition or lateral track obstacle clearance within an airport boundary or beyond an airport boundary, until the point at which cruise or other obstacle clearance requirements apply.

**c. Go-Around Assessment Conditions.**

Assessments may assume the following initial conditions:

1) A "balked landing" starts at the end of the TDZ.
2) An engine failure occurs at the initiation of the balked landing, from an all-engine configuration.
3) Balked landing initiation speed $\geq V_{REF}$ or $V_{GA}$ (as applicable).
4) Balked Landing initiation height is equal to the specified elevation of the TDZ.
5) Balked landing initiation configuration is normal landing flaps, gear down.
6) At the initiation of the maneuver, all engines are at least in a spooled configuration.

A touchdown zone (TDZ) typically is considered to be the first 3000' feet of a designated landing runway. When appropriate for the purposes of this provision, operators may propose to use a different designation for a touchdown zone. For example, alternate consideration of a touchdown zone (TDZ) may be appropriate for runways that:

- Are less than 6000' in length and which do not have standard TDZ markings,
- Short runways requiring special aircraft performance information or procedures for landing,
- Runways for STOL aircraft, or
- Runway where markings or lighting dictate that a different TDZ designation would be more appropriate.

**d. "One Way" Airports, "Commit Point", or Other Special Situations.**

Where obstacle clearance is determined by the operator to be critical such as for:

1) "One-way in", "opposite way out" airports in mountainous terrain, or
2) Runways at which a landing is to be planned or attempted, but at a weight which is significantly greater than that which would otherwise be allowed for a takeoff, or
3) Where rejected landing obstacle clearance may not be readily assured,

a review should be completed by the operator to determine whether a contingency go-around path can be appropriately defined or whether a "commit point" or equivalent condition is necessary (e.g., limit weight, speed, or configuration).

A "commit point" or equivalent condition however, should only be used where it is not otherwise possible to identify a safe go-around path. For a "commit point", the operator should either provide a representative weight, configuration or condition at which obstacle clearance can be assured after initiation of a balked landing at the TDZ, or identify a path related waypoint, location, altitude, height or fix, beyond which a go-around should not be attempted. For such determinations, the operator should consider at least the runway elevation, temperature, and appropriate aircraft configurations or configuration changes. If a "commit point" is used, the operator should provide any necessary advisory information to flight crews to address any events which, while unlikely, could nonetheless occur beyond the designated "commit" point or condition (e.g., unforseen significant wind shear, unacceptable winds, turbulence, or runway clutter, loss of visual reference, flare extending beyond the touchdown zone, or an obstruction on the runway).

**e. TERPS/ICAO PANS-Ops Criteria Not Applicable to "Non-Normal" Operations.**

TERPS or ICAO PANS-Ops based criteria do not typically address "special" instrument approach procedures, and they do not and are not intended to address non-normal operations (engine inoperative) or operations below published segments of instrument procedures (e.g., operations below DA(H) or MDA(H)). TERPS or ICAO PANS-Ops based criteria are intended only to address "standard procedures", normal operations (e.g., all-engine), and published segments of the resulting procedures. Thus, operator assessments of missed approach safety related to operations below published segments of instrument procedures, or operations with non-normal configurations or situations need not apply provisions of TERPS or ICAO PANS-Ops. Compliance with TERPS or ICAO PANS-Ops based instrument procedure requirements alone may not necessarily assure missed approach or rejected landing go-around safety. For example, it is recognized that certain types of aircraft (e.g., two-engine aircraft) may operate at weights which achieve gradients with an engine inoperative that may be less than TERPS or PANS-Ops gradients. Go-around from below DA(H) or MDA(H) (e.g., following loss of visual reference, or runway not suitable or available) does not necessarily provide for and does not need to apply TERPS or PANS-Ops criteria or provide for TERPS or PANS-Ops specified levels of obstacle clearance vertically or laterally. Methods related to TERPS or PANS-Ops criteria such as "Collision risk model (CRM)" also are not applicable to assessments other than for TERPS and PANS-Ops related procedure elements.

**f. Flight Guidance System (FGS) Use.**

If not already assessed for the aircraft type during basic type certification, flight guidance systems (FGS) suitability for the intended procedure(s) should be considered. The operator may need to assess FGS mode use to assure be compatibility with intended flight path, mode transitions, and gradient determinations. This may be achieved by demonstrating ( in simulation or flight) a safe go-around from 100 feet above the touchdown zone (HAT) operationally for the specific procedure or, if applicable, for the most critical runway for that operator. For aircraft that have airworthiness demonstrations conducted in accordance with Appendix 2 or 3 of this circular or AC120-28D this provision is considered to be addressed.

**g. Performance and Obstacle Data Availability and Use.**

Information or methods used by the operator for this assessment may be the best available information or methods from applicable aircraft manuals, terrain or obstruction charts, or supplementary information from aircraft or engine manufacturers. In the event performance, obstacle or flight path data is not otherwise available to support the necessary analysis from the above sources, the operator may develop, compute, demonstrate or determine such information to the extent necessary to provide for safe obstacle clearance during an engine-out missed approach or an engine-failure following a rejected landing. Data or methods used need not necessarily be from the applicable AFM or from the original aircraft manufacturer. Data or methods may be developed by the operator based on equivalence to other data or methods (e.g., takeoff data) or may be

derived by using standard practices applicable to aircraft performance assessment or procedure construction, or may be derived by appropriate aircraft performance or engineering analysis, techniques or methods.

Information on terrain or obstructions for these assessments may be based on the best available information to the operator or to the agency or entity supporting the operator at the time the information is supplied (e.g., data available to a performance information contractor, or chart supplier). Best available information may be used, notwithstanding that certain information or data may not necessarily be "approved" by an authority, or may be data that is not necessarily recent (e.g., certain types of charting or obstruction information is not frequently updated).

**h. Related Information.** Other sections of this AC contain information related to this section. Section 5.14 describes typical factors to be considered when assessing go-around capability for a particular aircraft and flight guidance system. Section 6 addresses procedures including those used for go-around or rejected landing, and Section 7 addresses Training and Crew Qualification including relevant aspects of missed approach, go-around, or rejected landing.

**4.3.2. ILS, GLS, or MLS (xLS) Instrument Approach Operations.** ILS, GLS, or MLS (e.g., xLS) operations may be authorized to the lowest applicable DA(H) for the procedure used, and to the lowest visibility minima specified in the OpSpecs for the NAVAID, facilities, and lighting systems used (see Appendix 7, Standard OpSpecs Part C Paragraph C053 for Category I, and Standard OpSpecs Part C paragraph C059 for Category II).

ILS, GLS, or MLS (e.g., xLS) operations are typically authorized based on use of two or more navigation receivers or multi-mode receivers (MMRs) of a pertinent type (see section14 CFR, part 121, section 121.349, and part 125 section 125.203), each providing independent information to the appropriate flight guidance system elements and pilot displays.

Provisions of sections 121.349, and 125.203 applicable to ILS may also be considered as applicable to GLS or MLS.

Provisions of section 121.349 for use of a single navigation (e.g., ILS) receiver are typically limited to operations using minima at or above RVR4000, or for Minimum Equipment List (MEL) authorization for dispatch with a NAVAID receiver inoperative.

Precision Approach Radar (PAR) procedures are not considered xLS procedures. For PAR procedures, see section 4.3.3.

**4.3.3. Instrument Approaches other than ILS, GLS, or MLS (xLS).** Instrument approach procedures other than ILS, GLS, or MLS (xLS) that may be authorized include the following.

**a. Standard Landing Aid (SLA) Approaches.** NAVAID specific procedures using a standard landing aid (SLA), without vertical guidance (e.g., non-precision approaches) as follows:

- Localizer (LOC),
- Localizer Back Course (BC)
- Localizer Back Course with Glide Slope,
- SDF
- LDA
- VOR,
- VOR/DME,
- NDB,
- Dual NDB,

- NDB/DME,

- TACAN, and

- RNAV (2D) based on a procedurally specified NAVAID (e.g., when a particular VOR/DME is specified as a "Procedure tuned" facility to serve as a basis for a particular RNAV procedure).

**b. Standard Landing Aid (SLA) Approaches with Vertical guidance (VNAV).** NAVAID specific procedures using a standard landing aid (SLA) with vertical guidance (e.g., procedures listed in a. above, but which are flown using a specified path for vertical guidance).

> **Note: NAVAID specific procedures flown using only "pilot procedural technique" to maintain a pre-determined vertical speed to achieve a corresponding assumed descent path (e.g., "open-loop" vertical speed descent profile) are not considered to be "vertical guidance". This is true regardless whether a periodic altitude/distance cross check is made or not (e.g., regardless whether a DME distance/altitude cross check is periodically made). While use of such procedures may nonetheless be desirable for aircraft that do not have FMS and VNAV, they are not considered to be eligible for VNAV capability credit.**

**c. "RNAV" Procedures (3D or 2D) based on Standard Landing Aids or Other Navaids.** RNAV Procedures (3D or 2D) may be based on standard landing aids (e.g., specified NAVAIDs, or other navaid or sensor capability such as GNSS). RNAV Procedures (3D or 2D) may also be based on NAVAIDs other than specified standard landing aids (e.g., FMS determined DME-DME position updating or VOR/DME updating from suitable and available NAVAIDs, or GNSS, or GNSS with GBAS or SBAS). Any of the preceding NAVAID sensor updating alternatives may also be combined with sensor information from one or more IRSs or equivalent. RNAV may also be based on combinations of sensors not considered standard landing aids (SLAs), if equivalent performance, availability and integrity is established.

> Note: For the purpose of this Advisory Circular a "3D" approach procedure (3D) is considered to be one having both lateral and vertical path guidance (e.g., three dimensions - with x, y, and z path coordinates). A "2D" procedure (2D) is considered to be one having only lateral path guidance (two dimensions - x and y path coordinates).

**d. "RNAV" Procedures (3D or 2D) using RNP based on Standard Landing Aids or Other Navaids.** RNAV procedures may be established as noted in item c. above, but with RNP based minima, or with use of RNP for some or all procedure segments (e.g., initial, intermediate, final or missed approach segments).

**e. Airport Surveillance Radar (ASR) Procedures.** ASR or international equivalent procedures may be used.

**f. Precision Approach Radar (PAR) procedures.** PAR or international equivalent procedures may be used.

**g. Other Limited Use Special Procedures.** Other special instrument approach procedures (e.g., LORAN, Transponder Landing System (TLS), airborne radar approach, Eastern European KRM).

Special procedures include use of LORAN C, airborne radar, or any other landing system or non-ICAO NAVAID. Special procedures typically require unique approval of an operator's operational procedures, flightcrew qualification, and maintenance programs as well as proof of concept demonstration prior to operational authorization. Special Category I operations, by definition, require the use of airborne and/or ground based or spaced equipment over and above the minimum equipment necessary to operate in the U.S. national airspace. Special Category I operations usually also require special knowledge, skills, proficiency, and procedures. As a result, changes and amendments to the operator's overall Category I operations program are usually necessary to ensure safe conduct of these operations. There is additional criteria which must be incorporated into an operator's program for special Category I operations.

**4.3.4. Applicability of a DA(H) or MDA(H).** Instrument approach and landing operations have limitations related to the minimum altitude (height) to which descent can be made without establishing visual reference (e.g., 14 CFR part 91,

Section 91.175). Minimum altitude or height to which descent can be made is typically related to assurance of clearance over terrain or obstacles, airborne instrumentation and equipment, NAVAIDs, and visual aids. Minimum height or altitude is usually specified as a DA(H) or MDA(H) and is used for various instrument approach procedures as described in sections 4.3.4.1 through 4.3.4.3.

Other expressions of minima may be used internationally. The U.S. equivalent minima to be used is described below for various types of approaches:

**a. DA, DH, OCA, OCL.** For xLS Approaches, the minimum height or altitude for instrument flight is specified as a DA(H) in the U.S. and many other countries. However, it may also be expressed as a decision altitude (DA), obstacle clearance altitude (OCA), decision height (DH), obstacle clearance height (OCH), or obstacle clearance limit (OCL). In the U.S, and other countries that use U.S. TERPS criteria, the minimum instrument flight altitude for precision approaches is considered to be the DA value of the DA(H) if minima are based on a barometric altimeter, or the DH value if based on a radio (radar) altimeter. For a barometrically specified DA(H) minima, the associated height value in parenthesis is considered to be advisory. For a radio altitude based minima the DH height value of a DA(H) is considered controlling and the barometric altitude value is advisory. A DA is specified as a decision altitude referenced to mean sea level (MSL) for QNH altimeter settings. A DA is specified in terms of HAT for aircraft using a QFE barometric altimeter setting. OCH and OCL are used in some countries in accordance with various revisions of ICAO PANS-OPS. OCA, where used, is referenced to a barometric altitude (MSL). OCH and OCL are referenced to a radio or radar height above either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

**b. MDA, MDH, HAT, HAA, OCA, OCH, OCL.** For Approaches other than xLS (e.g., non-precision approaches), the minimum height or altitude may be specified as a decision altitude DA of a DA(H) if suitable vertical guidance is provided (e.g., VNAV path), or specified as a minimum descent altitude MDA of a MDA(H) if vertical guidance is not provided. Minima may also be specified height above touchdown (HAT), height above airport (HAA), minimum descent height (MDH), obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL). MDA, HAT, and HAA are typically used by certain countries that use various earlier versions of U.S. TERPS criteria. OCA, OCH, and OCL are used in countries having procedures established in accordance with ICAO PANS-OPS. Although ICAO PANS-OPS now does not use OCL, some procedures still use OCL criteria from previous versions of PANS-OPS. Some countries, in addition to OCA and OCH, provide MDA and MDH. MDA and OCA are barometric flight altitudes referenced to mean sea level (MSL). HAT, HAA, MDH, OCH, and OCL are radio or radar altitudes referenced to either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

Accordingly, for international operations, the following equivalent minima formulations should be used by U.S. Operators:

(1) Use the altitude value of the MDA(H) where OCA may be specified for procedures other than xLS.

(2) Use the equivalent altitude value of the MDA(H) where HAT, OCH, or OCL are specified for "straight-in" approach procedures.

(3) Use the equivalent altitude value of the MDA(H) where HAA, OCH, or OCL may be specified circling approach maneuvers.

**c. Lowest Permissible DA(H) or MDA(H).** The lowest permissible DA(H) or MDA(H) for instrument flight (IMC) for any approach should not be lower than the most restrictive of the following, as applicable:

- Minimum height or altitude published or otherwise established for the instrument approach,

- Minimum height or altitude authorized in OpSpecs for the approach,

- Minimum height or altitude authorized for the flightcrew,

- Minimum height or altitude authorized for the operator, aircraft, and airborne equipment,

- Minimum height or altitude permitted by operative airborne equipment and NAVAIDs,

- Minimum height or altitude for which required NAVAIDs can be relied upon*,

- Minimum height or altitude which provides adequate obstacle clearance*, and

- Minimum altitude which provides compensation for extremely cold temperatures, if applicable**.

***Note: Item normally addressed by the published instrument approach procedure**

****Note: Applicable only when an operator has a procedure to correct altimeter errors for extremely cold temperatures (Typically T less than -22F/-30C).**

**4.3.4.1. Application of a Decision Altitude (Height) [DA(H)] for Category I.** Procedures established based on use of NAVAID electronic vertical guidance (e.g., ILS, GLS or MLS glideslope) use the barometrically based DA (of the specified DA(H)) for minima determination. Radio altitude above the approach terrain or touchdown zone, if provided, is advisory.

Procedures established based on use of other acceptable electronic vertical guidance (e.g., Baro VNAV meeting provisions of this Advisory Circular, GNSS based geometric path VNAV) may use a barometrically based DA (of the specified DA(H)) for minima determination if an appropriate obstacle assessment has been completed for the region between the earliest point along the approach path at which the DA may be reached, to the runway threshold. Radio altitude, if provided, is advisory.

For Category I a decision height (DH) is not used.

DA(H) is applied to Category I instrument approach procedures as follows:

**a) Category I ILS, MLS, or GLS (xLS) Approaches.** For Category I approaches based on ILS, MLS, or GLS (e.g., xLS, or precision approaches), a DA(H) is typically specified. The DA(H) represents the minimum altitude in an approach to which descent may continue, or by which a missed approach must be initiated, if the required visual reference to continue the approach has not been established. The DA(H) "altitude" value is typically measured by a barometric altimeter, and is the determining factor for descent minima for a xLS approach procedure. The "height" value specified in parenthesis is typically a radio or radar altitude equivalent height above the touchdown zone (HAT) used only for advisory reference, and does not necessarily reflect actual height above underlying terrain. Where a Middle Marker (MM) beacon is installed, it may be used as advisory information, confirming a barometrically determined DA(H) that is coincident with the glide slope altitude at that point.

For approaches which normally provide vertical guidance (e.g., xLS), but when vertical guidance capability cannot be used, such as due to an airborne system failure, see section 4.3.4.2 below.

**b) Category I Approaches with VNAV.** For Category I approaches other than ILS, MLS, or GLS which use a published VNAV descent path to the runway threshold, a DA(H) may be specified instead of an MDA(H). See (a) above for DA(H) applicability.

**c) Precision Approach Radar (PAR) procedures.** For Category I minima, a DA(H) may be specified for PAR. See section a) above for DA(H) applicability. Category II is not typically applicable to civil aircraft use of PAR (see 4.3.8.g).

**4.3.4.2. Application of an MDA(H) for Category I.** Procedures that are not based on use of vertical guidance (e.g., VOR, NDB, Back Course ILS) use the barometrically based MDA (of the specified MDA(H)) for minima determination. Radio altitude, if provided, is advisory.

**a) Category I approaches other than ILS, MLS, or GLS.** For Category I approaches other than ILS, MLS, or GLS, (e.g., non-precision approaches) an MDA(H) is typically specified. The MDA(H) represents the minimum altitude in an approach to which descent may continue, until either the required visual reference is established and the aircraft is in a position to continue the descent to land using normal maneuvering, or until reaching the specified missed approach point. The MDA(H)

"Altitude" value is typically measured by a barometric altimeter, and is the determining factor for descent minima for approaches other than ILS, MLS, or GLS (other than xLS) Category I instrument approach procedures. The "Height" value specified in parenthesis is typically a radio or radar altitude equivalent height above the touchdown zone (HAT), and is used only for advisory reference. This height value does not necessarily reflect actual height above underlying terrain. Where a VHF marker beacon (e.g., FM) is used, it may indicate a longitudinal position for a stepdown fix, if identified in the procedure.

**b) Circling Approaches.** Many instrument procedures provide for circling approach minima. Sufficient visual references for manually maneuvering the aircraft to a landing must be maintained throughout a circling maneuver. The pilot must keep the aircraft's position within the established maneuvering area while performing the circling maneuver. The circling MDA(H) or equivalent must be maintained until an aircraft is in a position from which a normal descent can be made to touchdown within the touchdown zone, using normal maneuvers and a safe descent path.

**4.3.4.3. Application of a DA(H), or equivalent (i.e. IM), for Category II.** Procedures using Category II minima typically use a radio altimeter and the associated DH (of the specified DA(H)) for minima determination. Barometric altitude is advisory.

Procedures that have "Radio Altitude Not Authorized (RA NA)", for example due to irregular underlying terrain, typically use the first indication of arrival at the "inner marker" as a means to establish DA(H). However an operator may elect to use first indication of arrival at either the "inner marker" or the barometric altitude DA , which ever comes first, as the means for minima determination. In the first instance , both radio altitude and barometric altitude are advisory. In the second instance barometric altitude may be an acceptable means to establish DA(H), but only if it occurs before arriving at the "inner Marker".

While for Category II the use of barometric altitude (DA) is advisory, this does not preclude an operator or flightcrew from initiating a missed approach if the altitude equivalent to the barometric altitude minima (DA) is reached prior to arrival at the specified DH. This applies regardless whether radio altimeter or inner marker determines the DH.

When a procedure specifies "RA NA", a DA(H) of 150' HAT is typically not used, since a marker beacon is not located in a position along the approach path corresponding to that minima. Instrument procedures may in cases retain this minima column simply to denote that the 150' HAT minimum is not available for use. This is for situations where an operator may have otherwise needed to know whether the 150'HAT/1600RVR minima is available for use (e.g., formerly required autoland constraint, which may still be applicable to operators who have not elected to update previously approved Operation-Specifications).

A barometrically specified "DA" is not currently used for air carrier Category II minima.

For Category II a Decision Height of a published DA(H) (or an equivalent Inner Marker [IM] for irregular pre-threshold terrain) is used as the applicable descent minima. Any "altitude" value specified is considered to be advisory. The altitude value is available for cross-reference and backup. Use of the barometrically referenced DA element of a published DA(H) is not currently authorized for part 121, 129 or 135 operations at U.S. facilities. If an operator elects to base discontinuance of an approach on the DA, if the DA is reached prior to the applicable DH, the DA element of a DA(H) may be considered applicable to Category II in other than an advisory capacity.

**4.3.4.4. "Specified Visual Reference" Requirements for Category I or Category II.**

FAR 91.175 and Standard Operations Specifications specify that for operation below the DA(H) or MDA(H) on an instrument approach, the required visual reference to continue the approach must be established. Unless otherwise authorized by the CMO (e.g., POI or APM for a particular type) the required visual reference may be considered to be those provisions as listed in FAR 91.175 items (c) and (d).

Circumstances in which the operator may request and the CMO may authorize use of alternative visual reference provisions might be situations such as where lower Category I or certain Category II minima are based on use of autoland or HUD (see Section 10.5.3). In this instance provisions such as those shown in FAR 91.175 (c) (3) (i) for "red terminating bars" or "red side row bars" may not be necessary or appropriate. This is because these particular approach lighting visual references or

configurations may not always be needed when operations are predicated on HUD or autoland use. They may not even be installed or applicable as a part of the approach lighting system for the runway or runways to be specially authorized. Conversely, for operations such as the ones noted above for autoland or HUD, it may be determined by the operator and CMO that continued descent below the DA(H) based solely on visual contact with a VASI (which may in instances be otherwise permitted by the FAR), but without having sight of either the runway, runway lights, touchdown zone lights, centerline lights or runway markings would not be appropriate. In this instance the CMO may authorize the operator to define and use alternate visual references or visual reference combinations for the lower Category I or Category II operations, rather than relying solely on the sighting of a VASI as a basis for continued descent below a DA(H).

**4.3.5. Visibility and RVR minima.** Visibility minima are as specified in Standard or Special Instrument Approach Procedures approved for use by the operator, or as otherwise listed in Standard OpSpecs applicable to that operator for Category I or II landing. Operating minimums may be expressed as meteorological visibility (VIS), runway visual range (RVR), or runway visibility values (RVV).

**a. Meteorological visibility (VIS).** Meteorological visibility may be used as reported by the NWS, a source approved by the NWS, by FAA, or a source approved by the FAA.

Outside of the U.S. meteorological reporting sources may be accepted for use by a particular operator by FAA. Outside the U.S. meteorological visibility determination may vary, and the operator should assure that the meaning, definition, and significance of any meteorological visibility reported for use in determining minima is understood by that operator's pilots.

For approval of use of weather sources other than the NWS (e.g., international), operators should consult their respective CMO, CMU, or POI. FAA FSDOs, CMOs, or CMUs that need assistance in responding to operator inquiries regarding approval of weather sources that are not otherwise already addressed by current directives (e.g., FAA Order 8400.10) should consult AFS-400.

**b. Runway Visual Range (RVR).** RVR is considered to be an instrumentally derived value measured by transmissometers. RVR is calibrated by reference to runway lights and/or the contrast of objects.

Controlling RVR means the reported values of one or more RVR reporting locations (TDZ, Mid, Rollout, or equivalent international locations) used to determine whether operating minima are or are not met, for the purpose of approach initiation, or in some cases, approach continuation.

All U.S. Category I operating minimums below 1/2 statute mile (RVR2400) and all Category II and III operating minimums are based on RVR.

Where RVR is used, the controlling RVR for Category I minima is touchdown RVR. All other readings are advisory.

For Category II minima, controlling RVR is as specified by operations-specifications.

RVR use has practical limitations that should be familiar to both the operator and pilot. For example RVR is a value which typically only has meaning for the portions of the runway associated with the RVR report (TDZ, MID, or Rollout). RVR is a value that may vary with runway light step settings (1 through 5). Operators should assure that pilots are familiar with runway light setting effects on reported RVR. RVR may not be representative of actual visibility along portions of the runway due to the location of the transmissometer baseline and limited length of the baseline, or due to variable conditions of fog, blowing snow, or other obscurations along the runway, or due to obscurations varying rapidly in time (e.g., patchy fog). Additionally, newer RVR systems may have localized performance sensitivity since they do not use a baseline along the runway (e.g., a scatter array may be used for visibility assessment). Thus, pilots and operators should note that RVR is an instrumentally derived value which has operationally significant limitations and can be greater than or less than the actual visibility available to a pilot at typical flight deck eye height (ground level) at the runway. This is particularly true at night, is true if runway lights are not at settings standard for the prevailing conditions, or if unusual daylight conditions are experienced such as when a runway is aligned with a sunrise or sunset condition, in shallow or patchy fog.

Outside of the U.S. some RVR reports may not necessarily be instrumentally derived by transmissometers or scatter meters, and may alternately be made by pilots or other weather observers. Accordingly, operators should assure that the meaning, definition, and significance and variability of any non-instrumentally derived value of RVR reported to the pilot for use in determining minima is understood by that operator, and that operator's pilots.

**c. Runway Visibility Values (RVV).** RVV minima are now used infrequently, are being phased out, and should be used only where minima cannot otherwise be specified as a meteorological visibility (VIS) or runway visual range (RVR).

**4.3.6. Visibility Assessment and RVR Equivalence for Landing.**

a. For instrument procedures where minima are expressed in terms of meteorological visibility, but reported visibility available to the flightcrew is specified as an RVR, the "visibility-RVR" equivalence table referenced in Standard OpSpecs may be used to establish equivalent meteorological visibility minima. See current Operations Specifications paragraph C051 (Example in Appendix 7).

b. Conversely, for instrument procedures outside of the U.S. where minima available to the flight crew on instrument procedures are expressed only in terms of RVR, but reported visibility available to the flightcrew by ATS or other approved source is specified only as a meteorological visibility and RVR is not reported, the "Visibility-RVR Equivalence" table referenced in Standard OpSpecs may be used to establish an equivalent RVR value (see Appendix 7, OpSpec paragraph C051). Use of this provision, however, specifically requires FAA authorization in addition to issuance of paragraph C051, and should be limited by the POI or CMO to only those operators and locations outside of the U.S. that have a need to use the "visibility-RVR" equivalence table for this type of determination.

**4.3.7. General Requirements for Category I Operations and Minima.**

**4.3.7.1 Category I Definition, Background, Classification and General Criteria.**

**a. Category I Definition.** Within the US, a Category I instrument approach is considered to be any instrument approach or approach and landing with a decision altitude (height) or minimum descent altitude (height) not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft).

**b. Background.** Originally the term Category I applied only to the difference between basic turbojet ILS minima and use of a 200 foot DH with a commensurate low RVR. Subsequently, the definition and common use of the Category I classification evolved several additional times, and variations in its use developed internationally. For US air carriers, the current Category I definition has been in use since FAA's Standard Operations Specifications were revised in the 1980s. Air carriers since that time have been issued these revised operations specifications, in both domestic and international operations.

This latest adjusted US Category I definition was necessary because previous criteria for instrument approaches relating to "precision" and "non-precision" approach classification was inadequate to address modern air carrier operations. Provision was not made for numerous levels of navigation system performance capability that are possible and needed by operators. Systems or methods such as FMS, RNAV, VNAV, electronic map displays, multi-sensor filtering, GPS, inertial systems, RNP, and various GPS augmentation schemes such as GBAS or SBAS now make possible significant improvements in instrument approach capability and cannot be suitably addressed by former criteria or classifications. Combinations of the above approach capability also cannot be adequately classified, represented, or used. Former classifications and criteria failed to appropriately consider the linear nature of modern RNAV systems, certain rare-normal and non-normal conditions, and often did not properly relate to necessary supporting airport systems (e.g., lighting, markings) or meteorological reporting capabilities (e.g., RVR). Previous criteria did not recognize that some procedures or systems formerly considered as "non-precision" (RNAV, RNP, or VNAV) may actually have superior performance to systems considered as "precision" systems (e.g., FMS can have better performance than ILS at and beyond distances several miles from the runway). With former criteria and classifications it was not easy to appropriately classify these systems or derive appropriate benefits.

An important consequence of the US definition for Category I is that, for an air carrier, any instrument approach with minima not less than a DA(H) or MDA(H) of 200 HAT, and visibility not less than RVR 1800, is considered to be Category I. This

means that VOR, NDB, RNAV, LOC, Back Course LOC and other such approaches, other than ILS or MLS, are also treated as Category I. This is true even though those approach types may have been considered "non-precision".

This use of Category I is important to consistently apply certification and authorization criteria for modern systems and procedures. It is also necessary to assure that operators or authorities can implement safety and efficiency advances in a timely and effective way, provide effective and uniform training, and provide necessary facilities, meteorological services and air traffic services.

**c. Instrument Approach Classification.** Accordingly, this advisory circular is based on and uses the definition of Category I as provided in 4.3.7.1. a.. The circular treats classification of instrument approach procedures as being grouped into any one of three broad classes:
1) "xLS",
2) "RNAV", and
3) "Instrument procedures other that xLS, or RNAV" (e.g., traditional or classic procedures such as VOR, NDB, LOC, ASR)

Procedures identified as "xLS" may apply to ILS, MLS or GLS.Procedures identified as RNAV include use of FMS, use of traditional VOR/DME based RNAV systems, and use of GNSS (GPS) or augmented GNSS systems other than GLS (e.g. includes SBAS/WAAS). RNAV procedures are addressed as either three-dimensional (3-D) if suitable LNAV and VNAV is used, or two-dimensional (2-D) if only lateral navigation is used. It is recognized that various levels of performance are possible either laterally or vertically. Hence, provision is made to address Required Navigation Performance (RNP). RNAV procedures are also considered to include those which may use RNAV methods, techniques or systems to fly traditional sensor specific VOR, NDB, or Localizer based approaches (e.g., use of FMS to fly a VOR, NDB or Back Course Localizer approach in LNAV and VNAV, based on an electronic map display rather than using a "raw data" readout of course deviation). The remaining instrument procedure group titled "Instrument approaches other that xLS, or RNAV" address traditional or classic procedures such as VOR, VOR/DME, NDB, LOC, BC LOC, ASR. This group is considered to include any other remaining types of instrument approach procedures that are not already covered by or addressed addressed by the groups xLS or RNAV.

The circular and associated classification schema do not use former terminology of "precision" or "non-precision" as applies to xLS or RNAV instrument approaches. However, it does not preclude continued use of the term by operators as apply to classic procedures, particularly when training materials or manuals may take a very long time to eventually be amended in the normal course of longer term revision. Since the terms "precision" or "non-precision" are not necessary to implement or conduct operations, and can be confusing and ambiguous, their use is discouraged in favor of use of the common generic term "instrument approach" or use of "xLS", "RNAV", or "approaches other than xLS or RNAV". for many important applications (e.g. Inappropriately classifying as "non-precision" operations of aircraft using RNAV systems to fly multi-sensor based and highly accurate levels of RNP and accurate VNAV paths, to a low DA(H)).

**d. General Criteria For Category I.** The following general requirements apply to the operational authorization of Category I instrument approach procedures:

1) The airborne system(s) should meet requirements of the applicable sections of 5.2 for the type of Category I procedures to be flown,

2) Appropriate NAVAIDs and airport/lighting facilities for the procedures to be flown should be available, consistent with section 8,

3) Flight crew qualification consistent with provisions of section 7 for Category I has been completed,

4) An acceptable airworthiness (maintenance) program for the airborne system is provided in accordance with section 9, and

5) An operational authorization has been completed in accordance with section 10 for a U.S. operator or section 11 for a Non-U.S. operator.

**4.3.7.1 Minimum authorized DA(H).** For simplicity of description, where a minimum authorized DA(H) is cited in this section as applicable to Category I mnima, it is stated in terms of a height above touchdown zone elevation (e.g., HAT value), even though operational minima for Category I are specified as a DA, based on MSL altitudes.

**4.3.7.2 "xLS" Procedures - Minima not less than 200' DA(H)**
Instrument approach operations that may be authorized **Category I** minima not less than **200' DA(H)** include at least the following:

1) ILS

2) GLS (GBAS/LAAS)

3) MLS

4) Special Procedures - Special procedures having individual FAA approval for each operator or location, which are capable of supporting a DA(H) down to at least 200' HAT may be authorized (e.g., PAR, GLS SCAT I). Such special procedures typically require associated conditions or limitations for special flight crew training, for navigation facility use coordination, site specific suitability review, or operator or other agency monitoring (e.g., as for DOD provision of PAR capability).

**4.3.7.3 "3D" RNAV Procedures - Minima not less than 200' DA(H)**
Instrument approach operations that may be authorized **Category I** minima not less than **200' DA(H)** include:

1) 3D RNAV procedures based on suitable levels of RNP and VNAV capability (e.g., RNP.15/125' or lower)

2) 3D RNAV procedures based on acceptable full capability GNSS/SBAS(WAAS) augmentation

**4.3.7.4 "3D" RNAV Procedures - Minima not less than 250' DA(H)**
Instrument approach operations that may be authorized **Category I** minima not less than **250' DA(H)** include:

1) NAVAID specific procedures flown using RNAV lateral and vertical guidance (e.g., "VOR Rwy 16R" flown using acceptable FMS LNAV and VNAV) such as a VOR, VOR/DME, NDB, Localizer or Localizer Back Course approach flown using RNAV, when the procedural identified NAVAID(s) are referenced in the FMS position determination, or when the procedure is flown with the crew monitoring the specified facility(s) by instrument display cross reference (e.g., RDMI raw data display, or equivalent),

2) RNAV (FMS LNAV/VNAV) Procedures overlaying a NAVAID specific procedure, when FMS position updating is referenced to "data base procedural tuning" of the specified facility(s) (e.g., "RNAV or VOR Rwy 16R" flown using acceptable LNAV and VNAV, with FMS using the appropriate procedurally identified NAVAID(s) along with any other applicable sensors for position determination),

3) RNAV (FMS LNAV/VNAV) Procedures overlaying a NAVAID specific procedure, when FMS position updating is not based on the "data base procedural tuning" of the specified facility(s), but instead is based on the FMS's selection of optimum navaids or sensors (e.g., "RNAV or VOR Rwy 16R" flown using an FMS which is using optimally identified sensors or NAVAID(s) combinations for position determination); These procedures may be flown with or without the underlying NAVAID operational,

4) RNAV (FMS LNAV/VNAV) Procedures not based on a specific ground based NAVAID, when suitable FMS position updating is used (e.g., a "GPS Approach" flown using a suitably capable FMS and appropriate updating capability), or

5) RNAV RNP based procedures with levels of RNP or vertical navigation capability other than as qualify under 4.3.7.2.

**4.3.7.5 "2D" RNAV Procedures (e.g., VOR/DME based RNAV, or GPS based RNAV) - Minima not less than 250' MDA(H).**
Instrument approach operations in this group may be authorized **Category I** minima of not less than **250' MDA(H).**

1) This group includes at least the following:
- 2D RNAV based on sensor inputs from GPS
- 2D RNAV based on sensor inputs from DME/DME
- 2D RNAV based on sensor inputs from VOR/DME
- 2D RNAV based on sensor inputs from combinations of LOC and VOR or DME

2) RNAV (2D - LNAV only) Procedures overlaying a NAVAID specific procedure (e.g., FMS/RNAV, used to fly an underlying VOR or NDB approach, but flown as a 2D RNAV procedure - without procedural tuning of the specified Navaid facility),

3) RNAV (FMS LNAV/VNAV) Procedures not based on a specific ground based NAVAID, when suitable FMS position updating is used (e.g., a "GPS Approach" flown using a suitably capable FMS and appropriate updating capability), or

4) Other FAA authorized RNAV based approach procedures (e.g., Loran, Airborne radar ).

**4.3.7.6 Procedures Other than xLS or RNAV (e.g., VOR, NDB, LOC, Back Course LOC, or ASR Procedures) - Minima not less than 250' MDA(H).**
Instrument approach operations in this group may be authorized **Category I** minima of not less than **250' MDA(H).**

1) This group includes ICAO or U.S. NAVAID specific procedures other than those based on xLS or RNAV, including at least the following:
- VOR,
- VOR/DME,
- NDB,
- NDB/DME
- LOC,
- LOC Back Course,
- LDA, and
- SDF

2) NAVAID specific procedures as listed in item 1above, but when flown with vertical guidance (e.g., using VNAV)

3) NAVAID specific procedures as listed in item 1above, but when flown with an "open loop" vertical speed based descent profile, and

4) Radar Surveillance Approach Procedures including ASR

**4.3.7.7 Other Special Procedures or Authorizations.**
Other special procedures or authorizations may be issued as follows:

1) Lower than Standard Category I minima authorizations may be issued, as addressed in FAA Order 8400.13, as amended (e.g., Authorization for HUD or Autoland RVR 1800 minima, when using limited facilities for approach lighting and runway lighting),

2) Special Obstacle Assessment Procedures may be issued for a particular runway, operator, or a group of operators (e.g., KDTW RW21R Special Authorization to use a 200' HAT DA(H) based on an obstacle assessment of the runway touchdown zone region and operator use of flight director or autoflight guidance systems.

3) Airborne Radar Approach authorizations may be issued to qualified applicants, for use with qualified airborne systems.

4) Special Limited Use (Non-ICAO) Procedures (e.g., TLS, KRM ).

**4.3.7.8 Previously Approved Category I Operations or Use of Previous or New Category I Criteria.**

Operators approved in accordance with criteria of earlier versions of AC120-29 (e.g., AC120-29 Change 3) for Category I, or operating in accordance with approved operations specifications for instrument approaches other than ILS, MLS, or GLS may continue to operate in accordance with their previously approved program, consistent with current standard operations specifications or any special provisions approved for that operator in that operators approved operations specifications.

Approval criteria used for a particular aircraft are typically listed in an AFM. If not shown in an AFM, the applicable FAA Aircraft Evaluation Group (AEG) may be consulted through the POI or CMO, to determine eligibility.

Aircraft qualified using other than FAA criteria will be as designated in approved Op-Specs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the aircraft type) or AFS-400.

Aircraft demonstrated to meet airworthiness provisions of previous versions of AC's AC 120-29 through Change 3, or criteria previous to AC 120-29, may remain eligible for previously approved operational authorizations. Additional airworthiness demonstration under provisions of this AC are not necessary for these aircraft unless additional credit based on meeting appendices of this AC is specifically sought.

Operators seeking credit provided for only by this version of AC120-29A, and which were not available in previous versions of AC 120-29 must meet operational criteria as described in the main body of this AC.

New airworthiness approvals addressing Category I, intended for use by an air carrier, may use criteria earlier than this AC only on a case by case basis as determined by FAA. Examples of cases where criteria prior to this AC may be acceptable include providing information from a service bulletin based on a previous version of AC120-29 to assure compliance status of an "in-service" aircraft. Another situation would be for continuing the production and delivery of an aircraft or autoflight system type which had a type certification basis using a preceding version of this AC, or when seeking certification of a new derivative aircraft which has an autoflight system the same as or very similar to one previously approved based on an earlier version of AC 120-29.

**4.3.8. Requirements for Category II.**

**4.3.8.1 General Category II Requirements.**
The following requirements apply to the operational authorization of Category II instrument approach procedures:

1) The airborne system should meet requirements of the applicable sections of 5.2 for the type of Category II procedures to be flown,

2) Appropriate NAVAIDs and airport/lighting facilities for the procedures to be flown, consistent with Section 8, should be available,

3) Flightcrew qualification consistent with provisions of Section 7 for Category II has been completed,

4) An acceptable airworthiness program for the airborne system is provided in accordance with section 9, and

5) An operational authorization has been completed per section 10 for a U.S. operator or section 11 for a Non-U.S. operator.

**4.3.8.2 Specification of a Category II DA(H).** To simplify description of Category II operations and minima, the lowest authorizable DA(H) for Category II is cited in this section as an equivalent DH related to wheel height above touchdown zone elevation (e.g., HAT value of 100 feet). This is done even though operational minima for Category II are typically specified as an equivalent DH value based on radio altitude height above the underlying approach terrain.

DH for a Category II procedure may be set and procedurally identified by the following nominal conditions:
1) The aircraft's navigation reference point tracks the center line of the glide path and FAS, and
2) Standard wheel to navigation reference point height and distance assumptions are used, and
3) A 100 foot or 150 foot wheel height HAT is assumed for the landing aircraft at DH, depending on minima to be specified,
4) A determination is made of the actual radio altitude above underlying terrain that occurs when an aircraft with nominal wheel to nav reference height reaches the point on approach where its wheel height first reaches 100 feet HAT.

Alternately a Category II DH may be set based on specifying use of a 100 foot DH above underlying terrain, regardless of circumstance in which the 100 foot above terrain point is reached. In this instance, the first point or time in which any aircraft, with any arbitrary wheel to nav reference height, pitch attitude, configuration, lateral displacement, or speed, first reaches the point at which 100 feet radio altitude is indicated above underlying terrain, the aircraft is considered to have reached DH.

While a DA is conceptually not precluded for use with Category II, DAs are not currently operationally used for Category II, except as a backup for inner marker based minima when irregular terrain precludes reliable radio altimeter use to determine minima.

**4.3.8.3 Eligibility for Category II minima not less than 100' DA(H).**
Instrument approach operations that may be authorized **Category II** minima not less than **100' DA(H)** include:

1) ILS,

2) GLS (GBAS/LAAS), and

3) MLS.

**4.3.8.4 Use of Inner Marker.**
Use of Inner Marker may be authorized in lieu of a DA(H). An Inner Marker is typically used at runways so designated by the applicable procedure, such as where radar altimeter use is limited due to irregular underlying terrain (e.g., RA NA).

**4.3.8.5 Barometric altimeter DAs not currently used for FAR 121 or FAR 135 Category II.**
Barometric altimeter specified DAs are not currently used as a basis for minima for air carrier Category II, except for those operators electing to discontinue an approach upon reaching either the DA or DH, which ever is reached first, when visual reference is not established, or upon reaching either the DA or IM, which ever is reached first, when using an IM as the basis for Category II minima.

**4.3.8.6 Category II on U.S. Type I ILS.**
Category II on FAA Type I ILS (limited to FAA specified locations) for certain qualified flight guidance systems. Instrument approach operations may be authorized Category II minima not less than 100' DA(H). Criteria for special authorizations for air carriers to conduct Category II operations on certain FAA Type I ILS facilities is contained in FAA Order 8400.13, as amended.

**4.3.8.7 Category II using RVR 300 "meter" minima.**
Category II using RVR300m minima (at designated international locations) may be authorized when meeting special provisions of Standard OpSpecs paragraph C059a. Note 1 (see Appendix 7). This provision permits an operator to be authorized use of Non-U.S. State minima of RVR300m with a DA(H) of 100' HAT at certain international runways qualifying for a minima less than that specified by ICAO for Category II. A flight guidance system meeting provisions of Appendix 7 Paragraph C059 Note 1 is required. Corresponding flightcrew procedures must be used. Following successful operational experience using this provision, FAA may determine that the above authorization may be also acceptable using an autocoupled approach to 100' HAT or other flight guidance system (e.g., HUD) without necessarily meeting other provisions for Category III. Following successful operational experience using this provision, FAA may determine that the above authorization may also be approved for use at certain U.S. facilities having appropriate Category II procedures with a minimum RVR of 1000 and a DA(H) of 100' HAT. For use of this provision internationally, where such operations are authorized by the State of the Aerodrome (e.g., certain European airports), FAA considers the operation to be the equivalent of a limited U.S. Category III operation (1000RVR), even though the State may locally classify or consider it to be Category II.

**4.3.8.8 Precision Approach radar (PAR)**
PAR Minima may be authorized to minima of not less than 200' HAT, or the published PAR minima, whichever is higher. PAR authorizations are limited to those operators and crews specifically qualified to use PAR. Request for PAR operations with minima below 200'HAT are approved only on a case be case basis, considering any special crew qualification required, the aircraft type and its characteristics (e.g., aircraft size, aircraft geometry, and PAR radar signature), and the specific facilities to be used.

**4.3.8.9 Previously Approved Category II Operations or Use of Previous or New Category II Criteria.**

Operators approved in accordance with earlier versions of AC120-29 (e.g., AC120-29 Change 3) for Category II may continue to operate in accordance with their previously approved program, consistent with current standard operations specifications or any special provisions approved for that operator in that operators approved operations specifications.

Approval criteria used for a particular aircraft are typically listed in an AFM. If not shown in an AFM, the applicable FAA Aircraft Evaluation Group (AEG) may be consulted through the POI or CMO, to determine eligibility.

Aircraft qualified using other than FAA criteria will be as designated in approved Op-Specs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the aircraft type) or AFS-400.

Aircraft demonstrated to meet airworthiness provisions of previous versions of AC's AC 120-29 through Change 3, or criteria previous to AC 120-29, may remain eligible for previously approved operational authorizations. Additional airworthiness demonstration under provisions of this AC are not necessary for these aircraft unless additional credit based on meeting appendices of this AC is specifically sought.

Operators seeking credit provided for only by this version of AC120-29A, and which were not available in previous versions of AC 120-29 must meet operational criteria as described in the main body of this AC.

New airworthiness approvals addressing Category II, intended for use by an air carrier, may use criteria earlier than this AC only on a case by case basis as determined by FAA. Examples of cases where criteria prior to this AC may be acceptable include providing information from a service bulletin based on a previous version of AC120-29 to assure compliance status of an "in-service" aircraft. Another situation would be for continuing the production and delivery of an aircraft or autoflight system type which had a type certification basis using a preceding version of this AC, or when seeking certification of a new derivative aircraft which has an autoflight system the same as or very similar to one previously approved based on an earlier version of AC 120-29.

**4.3.9. Runway Field Length Requirements and Runway Clutter.** For Category I or II, landing distance requirements are as specified by section 121.185, 121.187, 121.195 or 121.197.

The following typical means of complying with the above provisions of part 121 are considered to be acceptable. Examples are provided for turbine aircraft. Aircraft other than turbine powered aircraft, or aircraft operating under FAR parts other than FAR 121, may apply equivalent provisions in a similar manner.

Part 121 turbine aircraft operations must meet provisions of Section 121.195(b). Normally these landing distances (e.g., which already include the specified 60% factor) are factored into the AFM data provided for landing distance. They do not have to be added additionally or separately to the AFM data.

If during dispatch, in weather forecasts or reports, it is determined that the landing runway may be wet (e.g., may is considered to include "chance", "occasional", "temporary", or a probability equal to or greater than 10%), the effective runway length must be at least 115% (i.e., in accordance with FAR 121.195(d)) of the distance determined under FAR 121.195(b).

Unless otherwise authorized by FAA, wet is considered to be any condition "not clear and dry" on any part of the useable area of the runway (useable area does not include edges, sides, melting of ice or snow banks at edges or sides, area beyond the advertised plowed and sanded surface, overruns, etc.).

Note 1: FAA may authorize a wet grooved runway with good braking friction characteristics, or equivalent, to be considered a dry runway for purposes of dispatch determination. A wet runway is considered to be a runway that is other than clear and dry, and has no standing water.

Note 2: Aircraft for which a special demonstration has been made for stopping distance on a wet runway for compliance with FAR 121.195(d) may use information from this determination for low visibility landing distance assessment (see FAA AC 121.195-1A, as amended).

If any useable part of the expected landing runway or runways are slippery (e.g., wet and not-grooved or porous friction coarse (PFC), snow, slush, ice, or standing water) the provisions of section 121.195(d) apply. In addition, operators should consider the possible need for extra stopping distance beyond that required by 121.195(d) if braking action is reported or expected to be worse than "good". The amount of additional stopping distance, if any is determined by the operator to be appropriate, may be related to any estimated reduction in stopping capability for the assumed conditions.

Information on autobrake distance provided by the manufacturer may be used as the basis for Category I or Category II field length determinations. If AFM autobrake data is used as the basis for determining acceptable landing distance, the operator should assure that appropriate factors for use of autobrakes are considered, and if appropriate, accounted for (e.g. brake configuration, autobrake setting(s), runway surface friction, and ruwway slope). If a dispatch process applies, dispatch should consider, and provide any necessary information to the flight crew regarding any pertinent "autobrake settings" on which dispatch may be based. If autobrakes are to be used, it is not necessary to additionally factor autobrake stopping distance data by the 115% specified in FAR 121.195(d) beyond the stopping distance otherwise protected by FAR 121.195(d). However, if expected stopping distance based on using an autobrake system, or any particular setting(s) of an autobrake system, is greater than that protected by FAR 121 195(d), then the operator should take that fact into consideration and provide appropriate stopping distance information or stopping procedures to the flight crew.

When an operator needs to provide for an instrument approach and low visibility landing following an emergency return after takeoff, or when using a takeoff alternate, the operator should consider the expected landing configuration, braking method, and initial braking speeds in assessing landing field length requirements (e.g., consider landing weight, engine out flap settings, engine inoperative speeds as applicable, potential for partial brakes, or partial antiskid, or inoperative reverse thrust).

When determining alternate airport field length provisions (e.g., section 121.187 or 121.197 as applicable) it is recommended that the operator consider the weights, flap settings and approach speeds that may be applicable to use of that alternate airport with an engine inoperative. For credit for use of an alternate airport based on "Engine Inoperative Category II" capability, the operator must consider such representative speeds, as applicable to the engine inoperative configuration, in assessment of the required landing distance.

The following field length factors and considerations are considered acceptable:

**a. Category I Field Lengths.** For minima or conditions expected to be at or above RVR3000, the runway field-length requirement for Category I is as specified by FAR 121.195 for either a dry or wet runway. For minima or conditions expected to be below 3000RVR the field length requirement should be based on conditions for a wet runway (FAR121.195(d)).

Field length requirements are determined based on applicable weather reports and forecasts considered at the time of dispatch or release (i.e., section 121.195 reference to "takeoff"). Once an aircraft is enroute, it is recommended that field length requirements be reassessed if conditions significantly change from the conditions on which the departure was based.

**b. Category II Field Lengths.** The Runway Field-Length Requirement for Category II is as specified by FAR 121.195(d) for a wet runway.

When auto brake systems are used for Category II, information must be available to the flightcrew to assist in making the proper selection of a suitable auto brake setting consistent with the field length available for landing and the runway condition, including braking action.

Category II operations should not normally be conducted with braking action less than "fair" unless the operator has a method to assure that timely updates of field conditions are provided to the flightcrew, and if applicable also provided to the dispatcher, and that the flightcrew considers that sufficient runway length is available for the landing in the conditions reported.

**c. Runway field length Airborne Considerations.** Runway field length requirements are typically considered to be dispatch or release (pre-departure) requirements rather than "in-flight" assessment requirements. In the event of unforecast adverse weather enroute, or if braking system or other failures affecting stopping performance occur enroute, the crew should consider any adverse landing distance consequences that may result from a decision to make a landing on a particular runway (e.g., braking action reports, clutter).

**4.3.10. NAVAIDs or Landing System Sensors and Aircraft Position Determination.** Various landing system sensors (NAVAIDs) or combinations of sensors may be used to provide the necessary position fixing capability to support authorization of Category I or II landing weather minima. While certain navigation sensors (NAVAIDs) are installed and classified primarily based on landing operations, the sensors described in this section may also be used for takeoff, missed approach, or other operations (e.g., RNAV position determination). Regardless of the sensors, NAVAIDs, or combination of NAVAIDs used, the NAVAIDs and sensors must provide coverage for the intended flight path and for anticipated displacements from that flight path for normal operations, rare normal operations (e.g., winds and wind gradients), and for specified non-normal operations where applicable (e.g., "VNAV out" flight path, "engine-out go-around" flight path). In addition, Category I or II authorizations should be consistent with the provisions or characteristics for specific sensors listed below in 4.3.10.1 through 4.3.10.3 unless otherwise accepted or approved by FAA.

For NAVAID specific procedures (e.g., ILS), use of ICAO recognized NAVAIDs are eligible for authorization as either a Standard Instrument Approach Procedure or as a Special Instrument Approach Procedure. NAVAID types that are not recognized by or in ICAO criteria (e.g., in Annex 6, Annex 10, ICAO Doc 9365/AN910 Manual of All Weather Operations) are eligible only for authorization as Special Instrument Approach Procedures.

**4.3.10.1. Instrument Landing System (ILS).** The ILS provides a reference signal aligned with the runway centerline and deviation signals when the airplane is displaced left or right of the extended runway centerline. The linear coverage area for this signal is approximately 3 degrees either side of the extended runway centerline from a point emanating at the far end of the runway. The ILS also provides a vertical flight path (nominally 3 degree descent angle) to a point in the landing zone of the runway. The vertical coverage is approximately 0.7 degrees on either side of the vertical reference path. ILS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA. U.S. ILS systems are classified by Type as defined in FAA Order 6750.24 as amended (II/D/2, etc.).

**4.3.10.2. Microwave Landing System (MLS).** The MLS provides a reference signal aligned with the runway centerline and deviation signals when the airplane is left or right of the extended centerline. The linear coverage area is approximately 40 degrees either side of the extended runway centerline emanating from a point at the far end of the runway. The MLS provides a vertical flight path to the runway similar to ILS. MLS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA. U.S. MLS systems are classified by Type, similar to ILS.

**4.3.10.3. GNSS Landing System (GLS).** GLS provides is a landing systems based upon the Global Navigation Satellite System (GNSS). For lowest Category I minima and Category II operations the landing system typically includes a local area differential augmentation system in the vicinity of the runway for which lowest Category I or Category II procedures are specified. The local area system may serve one or more runways, or nearby airports, depending on its classification for each particular runway. The classification of a GLS service may be different for different runway ends (e.g., III/E/3 for Runways 14L and 14R, but I/D/1 for RW 22L). Desired path, centerline, and deviation signals as applicable, are computed by airborne avionics. The coverage area for GLS is typically within a 25 mile radius of a primary airport, but extended service volumes are permitted. GLS provides for both vertical and lateral flight path specification to the touchdown zone of the runway(s) served, and a lateral path for rollout or takeoff guidance. GLS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA (e.g., FAA accepted references to RTCA SC-159 MASPS). U.S. GLS systems should typically be classified by "Type" of system for each runway end served, similar to ILS (e.g., GLS II/D/2), or by an equivalent

schema. Authorization for use of GLS is for each specific air carrier, aircraft type, and GLS system type until pertinent GLS international standards accepted by FAA are promulgated.

**4.3.10.4. Satellite Systems.**

Navigation Satellite systems currently consist of the United States Global Position System (GPS) and the Russian Federation Global Navigation Satellite System (GLONASS). These systems may be considered part of a Global Navigation Satellite System (GNSS).

Various forms of augmentation exist or are in development including Space Based Augmentation Systems (SBAS), Ground Based Augmentation Systems (GBAS), and Aircraft Based Augmentation Systems (ABAS).

These augmentation systems may also be classified as wide area (e.g., EGNOS, WAAS) or local area augmentation systems (e.g., DGPS, LAAS).

GNSS may be combined with certain augmentation systems (e.g., LAAS) to provide a GNSS based Landing System (GLS).

**4.3.10.4.1. GPS/GLONASS and Reference Datum Information.** Satellite position fixing systems authorized for use by U.S. operators include GPS and FAA authorized augmentation systems for use with GPS (e.g., WAAS or LAAS). These systems may be used in the U.S., in U.S. territories, in other States that authorize GPS use, or in international airspace.

When using GPS or navigation systems that base position fixing on GPS, it is the responsibility of the operator to assure that in airspace outside of the U.S., that an appropriate Reference Datum (e.g., WGS-84) is used for definition of waypoint or critical path point coordinates. Information on states using WGS-84 or various other databases are typically available from commercial charting sources, and may be available on the worldwide web.

An example of one worldwide web data source for **"Datum"** information that is acceptable for use is:

**http://www.jeppesen.com/qref.html**

GLONASS, or other satellite position fixing systems than GPS, may be used only as approved by the CHDO/POI following coordination with AFS-400.

**4.3.10.4.2. Local Area Systems.** ~~Local area~~ Ground Based A~~a~~ugmentation S~~s~~ystems (GBAS) ~~(LAAS)~~ are considered to include the FAA's Local ~~a~~Area ~~a~~Augmentation ~~s~~System (~~GBAS~~ LAAS) and non-federally provided systems (e.g., ~~SLS~~ SCAT I).

Initial GLS/LAAS augmentation authorizations have been limited to use of a DA(H) not lower than 100' HAT. This value may be reduced as more capable airborne or ground based LAAS equipment is implemented or upgraded, amended criteria are issued, increasing numbers of GLS operational authorizations are issued for a wider variety of operating conditions, and satisfactory operating experience is gained.

Procedures based on any form of GBAS ~~LAAS~~ augmentation with performance that is equivalent to or better than a U.S. Type I ILS may be identified as "GLS" (GPS Landing System) procedures.

**4.3.10.4.3. Wide Area Systems.** Space Based Augmentation Systems (SBAS) ~~Wide area augmentation systems~~ include the FAA's wide area augmentation system (WAAS) and other internationally accepted ~~systems~~ wide area augmentation systems (e.g., EGNOS).

Credit for use of SBAS ~~WAAS~~ augmentation alone would currently be limited to use of DA (H) not lower than 200' HAT (e.g., when SBAS ~~WAAS~~ is not used as an input to a multi-sensor FMS system that also uses other sensors such as IRS).

Procedures based on any form of SBAS ~~WAAS~~ augmentation alone or SBAS ~~WAAS~~ augmentation in multi-sensor systems such as FMS should be identified as "RNAV" or "RNAV RNP" procedures, as applicable.

**4.3.10.5. LOC/LDA/SDF/Back Course.** Localizer, Localizer Descent Aid (LDA), Simplified Directional Facility (SDF), or Back Course ILS (BC) procedures are authorized for air carrier use, and may be authorized to Category I minima not less than 250' HAT.

**4.3.10.6. VOR.**

**Authorized Procedures.** VOR based procedures, when based on VOR alone, when based on multiple VORs, or when specified in conjunction with use of DME, may be authorized to use Category I minima not less than 250' HAT.

VOR or VOR/DME based procedures may be flown using any of the following flight instrument displays suitable for the procedure to be accomplished, and for course or intended flight path to be achieved, including:

- EHSI or ND Map Display,
- EHSI or ND Raw data display (e.g., EHSI lateral deviation display or VOR needle(s)),
- Electromechanical HSI,
- RMI, RDMI, or equivalent, or
- raw data lateral deviation display (e.g., cross pointer display) .

VOR procedures, when flown as a procedure without vertical guidance (e.g., without VNAV), should use an MDA(H).

VOR procedures, when flown with approved vertical guidance (e.g., with VNAV), may use either an MDA(H) or a DA(H), as determined to be suitable by the operator for the procedure or group of procedures to be flown.

The aircraft navigation system or flight instrument system display(s) used should be determined to be acceptable by the POI, for the procedures to be flown, considering that operator's routes, procedures, crew qualification, training, and recency of experience policies or programs.

**Use of a single VOR airborne system.** Other than following an in-flight failure of one of several installed airborne systems VOR receivers, instrument procedures based on VOR may be flown using a single airborne VOR receiver in lieu of two airborne VOR receivers (reference section 121.349) under the following conditions:

1) The operator is authorized to conduct procedures using a single airborne VOR (or TACAN) receiver, and

NOTE: Authorization for use of a single VOR may be for a specific procedure, a group of procedures, for an operator's particular fleet of aircraft (e.g., B727 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the U.S. and U.S. territories), as applicable to the operator's route structure, and fleet.

2) Instrument procedures requiring simultaneous use of more than one VOR NAVAID facility are not authorized, unless approved for that operator and each specific procedure, and

3) In the event of failure of the airborne VOR receiver, or other essential element of the airborne VOR navigation or display system, or the VOR NAVAID, the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

4) Following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed system or facility, to complete a safe missed approach and subsequent flight to an alternate.

NOTE: A period of dead-reckoning may be permissible between the time the VOR airborne system or VOR NAVAID failure occurs and the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID, without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.

**Use of RNAV for VOR, VORTAC, or TACAN Fix Substitution.**

VOR, NDB or TACAN cross track fixes may be authorized for substitution use with "xLS" procedures.

RNAV fixes based on FMS may be substituted for radial or cross track fixes.

Except for procedures that are specifically identified by FAA as prohibiting RNAV (FMS) fix use, RNAV cross track or along track fixes may otherwise be substituted for any VOR, TACAN, DME, NDB, Compass Locator, marker beacon, or other fix on any segment of a VOR, VOR/DME, ILS or MLS, LOC, LOC BCRS, or NDB, procedure where a corresponding VOR azimuth (radial) or TACAN fix is procedurally specified or can be determined by the FMS to the necessary degree of accuracy and reliability.

**Inoperative or Unsuitable VOR, VORTAC, TACAN, or DME NAVAID.** If VOR, VORTAC, TACAN, or DME updating is used in support of area navigation system (FMS) position determination, operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAD element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error)

**4.3.10.7. DME.** DME based procedures, when used in conjunction with VOR, NDB, LOC, LDA, SDF, or BC are authorized for air carrier use, and may be authorized to Category I minima not less than 250' HAT.

When used in conjunction with ILS or MLS, DME along track fixes may be authorized for use with Category I, II, or III procedures, as applicable to the specified procedure.

Except for Category II or Category III procedures that are specifically identified by FAA as requiring use of an Inner Marker, DME along track fixes may otherwise be substituted for any marker beacon, VOR, NDB, or Compass Locator on any segment of an ILS or MLS procedure where the corresponding DME value is procedurally specified or can be determined.

**Use of RNAV for DME Fix Substitution.** Suitable RNAV systems including FMS or GPS may be used to substitute for DME when equivalent DME fix information can be established by the flight crew. For this substitution to be authorized, suitable chart information and flight deck navigation system display information (e.g., electronic navigation map displays) must be available to establish the equivalent DME fix capability required for the areas, airspace, routes or procedures to be used by the operator. Such substitution may be applicable to normal inflight use, to continuation of flight after failure, or to dispatch with inoperative DME capability if consistent with the applicable MMEL for the aircraft type. The substitution of RNAV capability based on FMS or GPS must be determined to be acceptable for that operator by the CMO or POI.

**Inoperative or Unsuitable DME NAVAID.** If DME updating is used in support of area navigation system (FMS) position determination, operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAD element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error)

**4.3.10.8. NDB.**

**Authorized procedures.** NDB based procedures, when based on NDB alone, when based on multiple NDBs, or when specified in conjunction with use of DME are authorized for air carrier use, and may be authorized to Category I minima not less than 250' HAT.

NDB or NDB/DME based procedures may be flown using an appropriate EHSI or ND Map Display, EHSI or ND Raw data display, Electromechanical HSI, RMI, RDMI, or ADF display for course guidance, as determined acceptable to the POI considering the crew qualification, training, and recency of experience applicable to that operator.

NDB procedures, when flown as a procedure without vertical guidance (e.g., without VNAV), use an MDA(H).

NDB procedures, when flown as a procedure with approved vertical guidance (e.g., with VNAV), may use a DA(H).

**Use of a single NDB/ADF airborne system.** Other than following an in-flight failure of one of several installed airborne systems NDB/ADF receivers, instrument procedures based on NDB/ADF may be flown using a single airborne NDB/ADF receiver in lieu of two airborne NDB/ADF receivers (reference section 121.349) under the following conditions:

1) The operator is authorized to conduct procedures using a single airborne NDB/ADF receiver, and

NOTE: Authorization for use of a single NDB/ADF may be for a specific procedure, a group of procedures, for an operator's particular fleet of aircraft (e.g., B727 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the U.S. and U.S. territories), as applicable to the operator's route structure, and fleet.

2) Instrument procedures requiring simultaneous use of more than one NDB/ADF NAVAID facility are not authorized, unless approved for that operator and each specific procedure, and

3) In the event of failure of the airborne NDB/ADF receiver, or other essential element of the airborne NDB/ADF navigation or display system, or the NDB/ADF NAVAID, the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

4) Following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed system or facility, to complete a safe missed approach and subsequent flight to an alternate.

NOTE: A period of dead-reckoning may be permissible between the time the NDB/ADF airborne system or NDB/ADF NAVAID failure occurs and the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID, without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.

**Use of RNAV for NDB Fix Substitution.** Suitable RNAV systems including FMS or GPS may be used to substitute for NDB or ADF when equivalent NDB fix information can be established by the flight crew. RNAV (FMS) fixes may be authorized for use as an NDB substitute with Category I, II, or III procedures, as applicable. RNAV fixes based on FMS may also be substituted for bearing or cross track fixes. Except for procedures that are specifically identified by FAA as prohibiting RNAV (FMS) fix use, RNAV cross track or along track fixes may otherwise be substituted for any NDB, Compass Locator or other NDB based fix on any segment of a VOR, ILS or MLS, LOC, LOC BC, or NDB procedure where the corresponding NDB bearing is procedurally specified or can be determined by the FMS to the necessary degree of accuracy and reliability.

For substitution to be authorized, suitable chart information and flight deck navigation system display information (e.g., electronic navigation map displays) must be available to establish the equivalent NDB fix capability required for the areas, airspace, routes or procedures to be used by the operator. Such substitution may be applicable to normal inflight use, to continuation of flight after failure, or to dispatch with inoperative ADF capability if consistent with the applicable MMEL for the aircraft type. The substitution of RNAV capability based on FMS or GPS must be determined to be acceptable for that operator by the CMO or POI.

**Inoperative or Unsuitable NDB NAVAID.** If NDB updating is used in support of area navigation system (FMS) position determination, operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAD element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error)

**4.3.10.9. Radar Systems (e.g., PAR, ASR).** Various other systems are in limited use (e.g., PAR, ASR). These systems are considered for air carrier operations only as described below.

Air carrier approach operations using ASR or PAR may only be approved if OpSpecs contain authority for their use.

For use of ASR, dedicated training is not specifically required unless the POI determines that the operators general training and qualification program is not otherwise satisfactory for routine use of ASR procedures, and that specific ASR training is needed.

For use of PAR, dedicated PAR training is appropriate unless the POI determines that the operators training and qualification program is otherwise able to assure adequate crew preparation so that dedicated PAR/GCA training or demonstration is not needed (also see 4.3.8.g).

**4.3.10.10. Other Systems, Procedures and Special Systems.**

**Marker Beacons.** 75 MHz marker beacons are used in the NAS or internationally as part of ILS, and for other limited or special applications (e.g., stepdown fixes, departure turn points for instrument departure heading assignments). Use of marker beacons does not require dedicated crew training or qualification beyond that for conduct of ILS approaches.

**Airborne Radar Approach.** Operational authorization of use of any "airborne radar approach" procedure (e.g., use of ground mapping radar or equivalent) for purposes of conducting an instrument approach requires coordination with AFS-400, and may require proof of concept demonstration acceptable to FAA.

**KRM, RMS, SRE** or other unique systems or procedures which are not necessarily used in accordance with ICAO criteria (e.g., as used in certain parts of Europe) may only be approved for use by an air carrier if the aircraft is suitably equipped to receive and use the specified system and the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of US operations (e.g., ILS, LDA, ASR, RNAV using FMS). Minima authorized should not be less than any corresponding minima that would be applicable to an equivalent US procedure. If not otherwise an ICAO standard NAVAID, operational authorization of use of such systems should include coordination with the state of the aerodrome and with AFS-400, and may require acceptable review of use or demonstration of use to FAA (e.g., to a POI, APM or CMO).

**Transponder Landing System.** Transponder Landing System or other such "multi-lateration" systems may only be approved for an air carrier if the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of operations (ILS, FMS, etc.), to corresponding minima. Operational authorization of use of any of these systems requires successful completion of a proof of concept demonstration acceptable to FAA.

**Enhanced vision systems** are intended to provide the flightcrew with a visual presentation of a view of the approach to a runway that may otherwise be obscured by weather or darkness. Air carrier approach operations using these systems may only be approved if the system can meet the performance, integrity, and availability standards equivalent to those

established for currently approved types of operations (e.g., ILS, FMS, etc.), to corresponding minima. Operational authorization for use of enhanced vision systems requires successful completion of a proof of concept demonstration acceptable to FAA.

**4.3.10.11. Circling Approaches.** When instrument approach design criteria or operational factors do not permit a "straight-in" approach to the landing runway, circling procedures may be used. U.S. criteria require SIAP publication of circling maneuver minima if the inbound course is offset more than 30 degrees from the runway centerline, or when a specified descent gradient for a straight-in approach is steeper than a maximum value allowed by instrument procedure design criteria.

Use of circling minima, however, does not preclude a pilot making a straight in landing if the requirements of FAR 91.175 can be continuously met below DA(H) or MDA(H), to touchdown, for adequate visual reference and for normal landing maneuvering. Typically, circling approaches are based only on an MDA(H). Use of a DA(H) for circling is addressed because certain procedures using a DA(H) may apply to "sidestep" maneuvers, or may be used with very high values of DA(H), such as in mountainous areas that otherwise may require a circling maneuver to position to land after reaching minimums.

The circling maneuver can be initiated from any instrument approach procedure where circling is authorized, and may be continued below DA(H) or MDA(H) or beyond the missed approach point (MAP) only when the specified visual reference exists, and when in a position for a normal descent to landing. Electronic course or glidepath information, or FMS flight path presentations are only considered supplementary information to visually accomplishing the circling maneuver. The pilot must keep the aircraft's position within the established maneuvering area for the approach speed and category specified for the procedure while performing the circling maneuver. An altitude at or above the circling MDA(H) must be maintained until an aircraft (using normal maneuvers) is in a position from which a normal descent can be made to touchdown within the touchdown zone. A missed approach must be executed when external visual references are lost or sufficient visual cues to manually maneuver the aircraft cannot be maintained.

It is important to note that the published missed approach procedure may not provide obstacle clearance when below DA(H) or MDA(H), or when past the published missed approach point (MAP). If it is necessary to conduct a missed approach from below the DA(H) or MDA(H) or from past the published MAP (e.g., as a result of a balked landing, rejected landing, loss of visual reference, not in a safe position to land, blocked runway, or other similar reason for a go-around), reference to the associated IFR departure procedure for the applicable runway(s) usually provide help to the pilot in determining a safe course of action to climb back to procedurally protected airspace (adequate obstacle clearance) as specified by the published missed approach procedure.

When a missed approach from a circling maneuver is executed from below DA(H) or MDA(H) such as when visual reference is lost after passing DA(H) or MDA(H), or when initiating the missed approach from beyond the missed approach point such as when not able to maneuver to be able to accomplish a normal landing in the touchdown zone, the direction of the initial missed approach turn should typically be in a direction toward an appropriate runway, to assure obstacle clearance. This is to keep the aircraft within the maneuvering area, until climb above the DA(H) or MDA(H), and intercept of a published segment of the missed approach procedure can be accomplished. Pilots should be aware of the applicable radius of protected airspace for the respective approach category used for the circling maneuver, and attempt to maneuver the aircraft within that protected airspace radius from the airport.

Operators may be authorized to perform circling approaches as published, or may choose to not train flight crews to accomplish circling maneuvers, and accept corresponding high minima limitations regarding circling approaches. If an operator chooses to not train for circling approaches, a 1000 ft HAT DA(H) or MDA(H) and 2 mile visibility limit, or greater, is typically included in Operations Specifications to limit use of circling minima for that operator or aircraft type.

It is recommended that unless special circumstances exist, wide body (long wingspan) aircraft or aircraft needing to accomplish circling maneuvers at speeds in excess of 165 KTS ground speed should not typically be authorized circling minima below 1000' HAT and 3 miles meteorological visibility.

**4.4. RNAV/Flight Management Systems (FMS).** An FMS provides a means to navigate along a flight path based upon earth referenced waypoints. These waypoints can define a flight path that originates or terminates at a runway, or at other

relevant fixes located in terminal or en route airspace. This type of system may be approved for low visibility approach and missed approach operations in accordance with criteria in pertinent appendices of this AC and standard OpSpecs.

FMS systems eligible for use must meet criteria of AC 25-15, AC 20-129 and AC 20-130, or subsequent criteria, or equivalent criteria. Equivalent systems are considered to be those systems previously shown to meet AC90-45 which predated the above references, but would have otherwise been capable of meeting essential elements of the later criteria (e.g., B757, B767), or other aircraft which have subsequently been determined to be capable of meeting essential elements of the above criteria even though they were not specifically certificated using that criteria (e.g., certain non-US manufactured aircraft such as the A320).

For RNP operations, additional information is provided below and in sections 4.5 and Appendix 5.

**4.4.1 FMS Use for Procedures Other Than xLS or RNAV**

FMS may be used to conduct the following types of instrument approaches, other than RNAV approaches, when any suitable navigation position updating method is used by the FMS (e.g., "procedure" tuned facility, DME-DME-IRS, scanning DME, VOR/DME, or GNSS position updating; or Localizer (LOC) updating for Localizer (LOC) or Localizer Back Course (LOC Back Course) based procedures if a particular FMS requires use of such an updating method for those types of procedures):

- VOR,
- VOR/DME,
- NDB,
- NDB/DME,
- LOC, and
- LOC Back Course.

GPS approaches are considered to be an RVAV approach when flown by an FMS. GPS approaches may only be flown by those FMS systems which are capable of suitable GPS position updating, and have appropriate navigation data base information to properly load and display the procedure to the flight crew. Not all GPS approaches may necessarily be suitable for use with FMS because of procedure design, because of vertical path definition, because of inability to "call up" or "load" the procedure from a data base, because the FMS may not be able to appropriately recognize "GPS" as a type of approach classification, or because the airplane AFM may not suitably provide for GPS procedure use. Operators intending to fly "GPS approaches" using FMS should treat such procedures as RNAV procedures, and assure that the FMS can properly fly each procedure or each type of procedure to be used (e.g., LNAV/VNAV or LNAV only).

For any of the above approach types, the respective criteria of FAA Order 8260.3 (U.S. TERPS), and 8400.10 (including any pertinent HBAT(s) ), as amended, is applicable, unless otherwise approved by FAA. The criteria to be used should be the criteria for the type of procedure and associated NAVAID(s) to be used, or should be RNAV criteria, unless FAA has otherwise authorized the operator to fly the procedure(s) using an alternate FMS NAVAID updating method. When shown to provide suitable position fixing performance, alternate FMS multi-sensor position updating methods such as "IRS-GPS", "DME-DME-IRS"", "GNSS", or "scanning DME" position updating, may be approved in lieu of use of the "procedure tuned" navaid(s) updating method.

ILS, MLS, or GLS approaches or procedures are typically flown with FMS only to the extent that the FMS:

- Serves as a means to display the ILS, MLS or GLS procedure (e.g., as on a navigation map display),
- May be used to tune appropriate ILS, MLS or GLS NAVAIDs or radio frequencies,
- May be used to define and display and fly various LNAV or VNAV segments to intercept the final approach path or segment, or glideslope, or
- May be used to define, display and fly various LNAV or VNAV segments for a missed approach path.

Use of FMS to fly ILS, MLS , or GLS approaches when ILS, MLS, or GLS navigation aids are out of service (e.g., localizer or glideslope inoperative, or GNSS GBAS facility inoperative) may be authorized only in conjunction with RNP criteria (See section 4.4.3 below).

Other approach types may be authorized by FAA for use by FMS on a case by case basis for each operator or aircraft type.

### 4.4.2 FMS Use for RNAV

FMS may be used as a 2D or 3D RNAV system, as applicable, to conduct RNAV instrument approaches. For RNAV approach types, unless otherwise approved by FAA, respective criteria of FAA Order 8260.3 (U.S. TERPS), as amended, applicable to RNAV approaches is applicable and may be used. Vertical criteria of Appendix 5, FAA Order 8260.40A, 8260.47 or other subsequent applicable criteria acceptable to FAA (e.g., VNAV Provisions of FAA Order 8400.10 or any associated Handbook Bulletins for Air Transportation [HBAT]), may be used to specify vertical obstacle clearance criteria for use of VNAV.

RNAV procedures may be authorized based on one or more "procedure specified" NAVAID(s) (e.g., the FMS data base identifies a specific VOR/DME "Procedure tuned ("P" tuned)" NAVAID, or a combination of specific DME facilities to use as a basis for the procedure).

RNAV procedures may also be authorized based on use of a "NAVAID rich environment" in which specific "procedure identified" NAVAIDs may not be identified, but rather the FMS is permitted to select optimum navaids from those available. When such RNAV and navaid updating procedures are used, the navaid service provider, authority or operator must assure that the normally selected navaid(s) and the alternately selected navaid(s) suitably support the procedure to an acceptable level of accuracy and availability (e.g., at ranges, at altitudes, and along the expected flight paths relevant to achieving appropriate system approach performance). For an FMS which uses DME-DME or VOR-DME based navaid sensors in conjunction with IRS, in a navaid rich environment, this can typically be accomplished by analysis, or by in-flight assessment (usually during line operations) to show suitable Navaid reception for normal facilities to be used and for the first alternate facilities anticipated to be used for a particular system and procedure if the normal facility(s) become unavailable. For equivalent RNAV procedure assessments for RNP qualified aircraft see section 4.4.3.3 below.

RNAV procedures which do not use "procedure tuned facilities" may be authorized for use with multi-sensor FMS based on use of "DME-DME" updating, "VOR/DME" updating, "scanning DME" updating, or "GNSS (GPS)" updating. These methods may be used individually, or may be used in combination, or may be used in conjunction with inertial position filtering.

**Use of a single RNAV airborne system.** Other than following an in-flight failure of one of several installed airborne RNAV systems (e.g., failure of one FMS), instrument procedures based on RNAV may be flown using a single airborne RNAV receiver in lieu of two RNAV systems (reference section 121.349) under the following conditions:

1) The operator is authorized to conduct procedures using a single RNAV (FMS) system, and

NOTE: Authorization for use of a single RNAV may be for a specific procedure, a group of procedures, for an operator's particular fleet of aircraft (e.g., B737 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the U.S. and U.S. territories), as applicable to the operator's route structure, and fleet.

2) Instrument procedures requiring simultaneous use of more than one RNAV system are not authorized, unless approved for that operator and each specific procedure, and

3) In the event of failure of the airborne RNAV system, or other essential element of the airborne RNAV navigation or display system, or associated NAVAID(s), the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

4) Following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed RNAV system or facility(s) used by that system, to complete a safe missed approach and subsequent flight to an alternate.

NOTE: A period of dead-reckoning may be permissible between the time the RNAV system is used and reversion to another system, or following NAVAID failure, to the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of

obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID(s), without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.

### 4.4.3 FMS Use for RNAV With RNP

RNP operations may be based on capability as specified in an FAA approved AFM. RNP operations may also be based on "Fleet Qualification" of and individual aircraft, a group of aircraft, or an aircraft type using criteria acceptable to FAA (e.g., RTCA DO-236 Appendix D for RNP Fleet Qualification).

Approach or departure RNP operations for an air carrier typically require dual FMS capability for RNP.

See section 4.4.2 above for operations and limitations that may apply for a single FMS with RNP capability. In addition, procedures for departure or approach for air traffic separation that are based on use of RNP may require use of dual RNP capable systems, when so designated.

#### 4.4.3.1 Standard RNP Qualification

FMS may be used as a 2D or 3D RNAV RNP system, as applicable, to conduct RNAV instrument approaches based on aircraft qualification for RNP operations through an approved AFM and use of appropriate RNP obstacle clearance criteria. For RNP approaches, unless otherwise approved by FAA, respective criteria of Appendix 5 applicable to RNP based RNAV approaches is applicable. RNP vertical criteria or vertical criteria of FAA Order 8260.40A, or other criteria acceptable to FAA, may be used to specify vertical obstacle clearance criteria for use of VNAV.

#### 4.4.3.2 "Fleet Qualification" For Use of RNP

FMSs which do not incorporate provisions for RNP as part of their type design approval, but nonetheless meet applicable provisions of RTCA DO-236 Appendix D for fleet qualification for one or more RNP levels, may use corresponding RNP procedures and criteria (e.g., see Appendix 5 for RNP based obstacle criteria). For these FMS systems, if specifically approved by FAA for use of applicable RNP levels, respective criteria of Appendix 5 applicable to RNP based RNAV approaches may be used. RNP vertical criteria or vertical criteria of FAA Order 8260.40A, or other criteria acceptable to FAA, may be used to specify vertical obstacle clearance criteria for use of VNAV. Examples of aircraft and systems which may typically "fleet qualify" under this provision would be aircraft having IRS and dual FMS incorporating GPS updating, or dual FMS using DME-DME or scanning DME updating when the aircraft is operated in an area with a significant number of DME facilities. A significant number of DME or other NAVAID facilities are considered to be a number which provide for adequate signal coverage in the event of failure of any single facility, and with more than one facility or facility pair providing acceptable position update geometry and accuracy, considering the updating requirements for the FMS and any other relevant sensors used (e.g., IRS, IRU, ADIRU). Typically aircraft having FMS and sensor systems such as these are considered to meet either /E or /F flight plan classification.

For fleet qualification credit, aircraft and systems meeting the following capability, or equivalent capability (e.g., for aircraft systems described named or described differently but providing equivalent capability), may be considered eligible for the specified levels of RNP, as shown below.

a) RNP 2.0 or greater:
   1. Autopilot in "Command", or
   2. Flight Director in LNAV, and
   3. Availability of an "IRS Only" annunciation message should suitable NAV updating not be available.

b) RNP 1.0 or greater:
   1. Autopilot in "Command"*, or
   2. Flight Director in LNAV*, and
   3. Availability of an "IRS Only" annunciation message should suitable NAV updating not be available.

4. A periodic confirmation of suitable navaid or position sensor updating

b) RNP .3 or greater:

1. Autopilot in "Command"*, or
2. Flight Director in LNAV*, and
3. Availability of an "IRS Only" annunciation message, should suitable NAV updating not be available, and
4. A 10 mile EFIS Map Scale (or lower map scale), showing the designated flight path (e.g., FMS designated green or magenta flight path line), with a suitable aircraft position symbol allowing a pilot to suitably monitor availability of a correct flight path, and aircraft path displacements (FTE),**
5. If not otherwise assured by system performance or flight deck annunciation, a "reasonablenes check" for acceptable position fixing error to be completed not later than passing a Final Approach Fix (FAF), and
6. A navaid or sensor updating capability suitability cross check, performed not later than passing a Final Approach Fix (FAF)***.

*Note: Credit may be limited by Flight Technical Error (FTE) capability that can be achieved .

**Note: Credit for systems other than EFIS "map displays" (e.g., systems using only an HSI or lateral deviation scale display) for RNP may be permitted, but credit is limited to use of "simple procedures". Simple procedures are considered to be those procedures not involving: Multiple short flight path segments, frequent or large angle turns, critical obstacles adjacent to turns, adjacent aircraft flight paths with turns, adjacent significant or mountainous terrain, use of multiple or complex VNAV gradients, procedures not requiring a high level of pilot "situation awareness" to detect and correct the consequence of flight path definition or waypoint difficulties (e.g., an FMS "Legs Page" waypoint "Bypass"), procedures not unduly sensitive to pilot setup errors or mistakes made in programming a navigation system that could readily be detected when using a map display, or procedures that require unusual levels of attention, FTE monitoring, or other criticality that are aided by use of a map display.

***Note: May be a limiting factor for the level of RNP to be authorized, considering the pilot or operator's ability to assess position fixing errors as relate to sensors or navaids intended to be used.

#### 4.4.3.3 Assessment Credit for RNP qualified aircraft flying "non-RNP" based RNAV Procedures

RNAV procedure assessment credit may be based on an RNP (AFM qualified) aircraft flying non-RNP based RNAV procedures to demonstrate that acceptable system performance is achieved and that a navaid rich environment (e.g., DME-DME IRS or RNAV-DME IRS updating) is capable of appropriately supporting an RNAV procedure for that aircraft and system type. For such assessments it is acceptable for an operator to show that the demonstrated ANP (EPE) remains below an acceptable value (e.g., .3 nm) throughout an approach, and any applicable parts of a missed approach, for the normal and first alternate FMS navaid facility selections expected to be used (see section 4.4.2 above).

#### 4.4.3.4 Assessment of Expected Levels of ANP for RNP qualified aircraft flying "RNP" Procedures.

When RNP qualified aircraft (Either "AFM Qualified" or "Fleet Qualified") fly "RNP" based RNAV procedures, suitable levels of expected ANP (e.g., anticipated, projected, or achievable ANP) should be available appropriate to the level(s) of RNP intended and the procedures used.

An ANP navigation services assessment may apply to an airspace, areas, routes, procedures or operations planned or otherwise intended (e.g., contingency alternates). The assessment may be accomplished by any one or more of a variety of technically qualified people or organizations, including the operator, a pilot, a fleet manager or other qualified representative of the operator (e.g., dispatcher), an authority, airspace planners, procedure developers, air traffic services, charting agencies, through ICAO global or regional agreement, by technically qualified supporting contractors to any of the above entities, or by a relevant aircraft or avionics manufacturer.

When determining the suitability of the airplane/system to achieve the expected level(s) of ANP, the person or organization accomplishing the assessment should refer to appropriate airplane and system material. The expected levels of ANP should be applicable to the system or systems to be used (e.g., airborne system as well as supporting navaids or space based system elements external to the aircraft), should be suitable to support the level(s) of RNP to be used for the time period(s) to be used, and should be compatible with the airspace or procedures to be used (e.g., consider geographic or geometric effects such as "terrain masking", if applicable).

Acceptable source material for determining anticipated, expected, projected, or achievable ANP may include any one or more of the following:

- Information from an applicable aircraft AFM,
- Information from an applicable aircraft operating manual,
- Applicable operational navigation documents (e.g., Systems Requirements and Objective (SR&O) documents) available from the aircraft or avionics manufacturer that apply to a navigation system,
- Appropriate authority or air traffic service provider assessments or airspace studies,
- Appropriate published instrument procedure provisions,
- Authority, ATS provider, or ICAO specified navaid locations, standard navaid characteristics, navaid performance and service volume charts or plans,
- Published GNSS satellite constellation characteristics or GNSS augmentation method characteristics found acceptable to FAA and the State of the Aerodrome, or ICAO,
- NOTAM information,
- AIP or AIM, or equivalent, information,
- Appropriate studies or assessments conducted by an operator found acceptable to FAA, or
- Any other source material able to help assess projected ANP that is found acceptable to FAA.

### 4.4.4 FMS VNAV

FMS procedures typically use vertical navigation capability (VNAV) based on a barometric pressure based VNAV path (e.g., Barometric (Baro) VNAV). FMS systems may also use a VNAV path based on a geometrically defined VNAV path which is fixed in space by "earth centered earth fixed (ECEF) coordinates" (e.g., fixed relative to earth reference

and does not vary with barometric pressure - analogous to an ILS Glide Slope, except does not compensate for earth curvature). In this AC these paths are referred to as "ECEF Geometric VNAV Paths"

ECEF Geometric VNAV Paths (if and when used) typically are only used for final approach segment path definition. ECEF Geometric VNAV Paths, if used in either an FMS or instrument procedure, must be clearly distinguished from Baro VNAV paths ,and must have clearly defined and compatible transitions from Baro VNAV paths to the ECEF Geometric VNAV Path.

Baro VNAV paths may be used for all applications including final approach paths.

Baro VNAV paths may be defined as follows:

1) Baro VNAV paths with constraints for "at", "at or above" "at or below", or the proceeding with corresponding speed constraints.

2) Baro VNAV geometrically based path defined as an approximate straight line segment from from one defined WP pressure altitude to another WP pressure altitude (following earth curvature), or

3) Baro VNAV geometrically based path defined as two approximate straight line segments from from one defined WP pressure altitude to another WP pressure altitude (following earth curvature), but using a reduced gradient for the final part of the path preceeding the "to" WP to accommodate a speed constraint at the "to" WP, or

4) Baro VNAV Performance based climb or descent paths may be used.

5) When used for a final approach segment, VNAV paths may be based on a defined descent path angle rather than a segment between two sequential WP barometric altitudes.

6) For credit within this AC for use in a final approach segment (e.g., DA(H) credit) a Baro VNAV path should:

a. Meet provisions of AC20-129, as amended, for VNAV, or equivalent (eg., equivalent means aircraft such as the B757 or A320 which meet AC90-45A or other earlier international standard as a certification basis, but have systems which operationally have been determined to meet objectives of AC20-129. Such aircraft system designs preceded issuance of AC20-129, and were the basis for its subsequent development),

b. Be capable of providing vertical tracking performance within $\pm$ 125 ft vertically (two sigma) (e.g., meeting or meeting the equivalent of RNP 0.3/125' for the vertical performance component), excluding temperature correction for deviaton from ISA, (see 4.2.5-1), and

c. Alternately, FMS systems may provide or additionally more accurate vertical tracking performance within $\pm$ 45 ft vertically (two sigma) or + 15' vertically (e.g., meeting or meeting the equivalent of RNP x.xx/45' or RNP x.xx/15' for the vertical performance component), excluding temperature correction for deviaton from ISA, (see 4.2.5-1), and

d. Provide a VNAV path vertical displacement scale display showing a displacement range within at least $\pm$ 550' or less (with a scale of $\pm$ 400' recommended), unless meeting the more stringent requirement of Advisory circular Section 5.9.2 Figure 5.9.2-1for final approach segment displays.

It is also recommended that the FMS systems have digital readout capability available to the pilot showing vertical displacement (e.g. FMS progress page or equivalent).

For "Go-Around", when using a VNAV path for a final approach segment and a corresponding DA(H) is authorized for use, momentary descent below the DA(H) is considered acceptable while the aircraft transitions from the descent approach path to a missed approach. Typically this momentary descent is less than 20' below DA(H) but in adverse environmental circumstances it could be as much as 50' below DA(H) and still be considered acceptable.

Vertical criteria provided for obstacle clearance in Appendix 5 of this AC, or FAA Order 8260.40A, or other criteria acceptable to FAA (e.g., VNAV Provisions of FAA Order 8400.10 and associated HBAT(s)), may be used to specify vertical obstacle clearance criteria for use of VNAV.

**4.4.5 FMS Use for International Procedures**

For international operations (e.g., for instrument procedures outside the US), equivalent criteria to the criteria specified above (e.g., ICAO PANS-OPS) may be used. In addition, operators may use criteria of this AC, and related US criteria referenced by this AC, internationally when approved by FAA, and when found acceptable by the "State of the Aerodrome" for the procedure being used. For international operations it may be important to apply provisions of this AC regarding use of an appropriate Waypoint or NAVAID reference datum (e.g., WGS-84 see Section 6.2.17), or provisions for extreme cold temperature correction (see Section 8.13).

**4.4.6 FMS RNAV Use for Substitution for VOR, DME, NDB, or Marker Beacon Navaids or Fixes**

Where suitable navaid updating of an FMS or GNSS navigation system is available, FMS or GNSS based RNAV may be used to substitute for inoperative or unavailable VOR, DME, NDB, or Marker Beacon navaids or fixes for approach procedures, missed approach procedures, or departure procedures. For such substitution, except as provided in item 4 below where an authority has already specified an acceptable substitution, the operator should assure that the navigation system used and updating method available, taken with the available remaining navaid(s) or sensors are suitable for the route or procedure segment to be flown.

FMS RNAV substitution for VOR, DME, NDB, or Marker Beacon navaids or fixes may be applied if:

1) The operator can assure the necessary accuracy of the aircraft's RNAV system to substitute for the desired fix, navaid or waypoint, and
2) If the aircraft's navigation system is able to suitably depict the substitute WP, facility, or fix, and
3) The aircraft can suitably fly any applicable leg, route, or procedure segment that otherwise would be based on the inoperative navaid or unavailable fix, or
4) If the responsible authority (e.g., FAA or JAA) has otherwise established or provided for, and the operator uses, an acceptable RNAV substitution (e.g., in accordance with AIM GPS substitution provisions for NDB or DME, or FAA's enroute navaid RNAV substitution policy, or in accordance with an acceptable RNAV substitution method promulgated via NOTAM).

(Also see provisions for various specific navaid types within Section 4.3.10, such as 4.3.10.7 for inoperative DME substitution).

**4.4.7 Inhibiting RNAV System Use of Inoperative or Unsuitable VOR, DME, VORTAC, TACAN, or NDB NAVAIDs.** If VOR, DME, VORTAC, TACAN, or NDB updating is used in support of area navigation system (FMS) position determination, operators and flightcrews should be aware of when and how to disable RNAV system use of an unsuitable NAVAID or NAVAD element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

**4.5. Required Navigation Performance (RNP).** RNP is a navigation performance standard for a particular area, airspace, route, procedure or operation. A definition of RNP is specified in Appendix 1.

The specification of RNP has two major aspects, the airspace (e.g., area, route, route segment, leg, procedure or particular operation) and the airborne system. The airspace requirement is to specify airspace, routes, procedures or operations within which the aircraft must be located with a high degree of assurance. The airborne systems requirement is to provide a level of performance that is reliable, repeatable, and predictable. The airborne system specification of navigation performance is as defined in RTCA DO-236, or equivalent (e.g., as agreed in an FAA approved certification plan), except as otherwise found acceptable to FAA.

Application of an appropriate airborne specification for RNP serves as a basis to ensure that airborne system performance will match or exceed the level necessary for the area, route, route segment, leg, procedure or operation. RNP criteria have currently been developed and applied for area navigation standards for use with lateral types and levels of RNP (e.g., types such as addressing 95% lateral performance only, or addressing lateral performance using RNP x 2 containment areas, or various levels of RNP such as RNP .3, RNP .5, RNP 1). Extension of the RNP concept to other types or levels of RNP (e.g., levels such as RNP .15/45') represent more stringent lateral and vertical performance standards that may in the future be applied to approaches or 3D terminal arrival and departure VNAV paths. Other future applications of RNP may provide for , along track performance (e.g., "Required Time of Arrival (RTA)" ) and are anticipated to evolve as general navigation requirements and operational concepts evolve. Hence this AC currently addresses only initial RNP applications, and recognizes that RNP criteria will continuously evolve to address other future operational requirements as necessary to define and manage evolutionary changes in the International Airspace System (INAS). Accordingly, different aircraft may meet RNP requirements in different ways regarding sensors used or criteria met (e.g., FANS 1, FANS A, RTCA DO-236, Fleet qualification). Regardless of RNP application however, it must be possible to determine that each specific aircraft meets the level of RNP required for the airspace application, and that a suitable identifiable standard has been applied.

RNP addresses the aircraft and navigation service (non-aircraft) accuracy, integrity, continuity and availability requirements for normal and rare fault-free performance and for performance with failures. RNP specifies the nominal and limit lateral, and if applicable, vertical flight path displacements permissible for a particular procedure. RNP can be related to obstacle clearance or aircraft separation requirements to ensure a consistent set of operational procedures and design requirements.

The following elements of RNP, and error components, are thus considered applicable to systems and operations, as defined and described below in Figure 4.5-1.

A **desired flight path** is the path that the pilot, or pilot and air traffic service, expect the aircraft to fly. A desired flight path may be identified by the pilot, by ATS, by an airspace planner or by a procedure developer. It is typically specified in the form of a route or procedure, or is as otherwise identified by ATS in a pre-specified flight plan or clearance, or is as defined by an ATS clearance issued in "real time" (e.g. an assigned track, radial, bearing, course, arc, or heading). The desired flight path may be a simple straight segment, may be a path defined by multiple waypoints connected by straight segments, or may be a complex path defined by continuous straight and curved segments. The path may be defined in two dimensions (2D) consisting of lateral and longitudinal elements, three dimensions (3D) including vertical path elements, or may be defined in four dimensions (4D) including a longitudinal position as a function of time elements, or "time of arrival" constraints at waypoints.

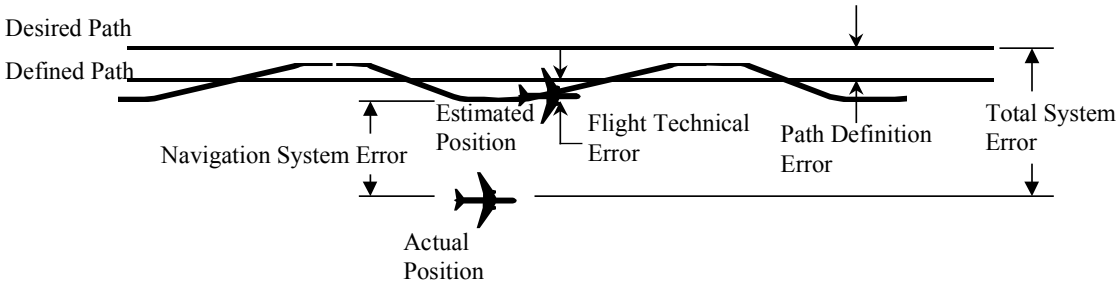
In order for an aircraft to follow the desired flight path it is necessary that the navigation system (airborne or on the ground) generate a **defined flight path.** The defined flight path is the path as determined by the path definition function of an aircraft's navigation system (Note: It may also be defined by a system external to the aircraft, and intrinsically provided, or otherwise communicated to the aircraft). While the defined flight path is typically intended to be the same as the desired flight path, the defined flight path is often only a close approximation to the desired flight path due to unavoidable path definition error factors. Factors such as non-spherical earth shape or curvature, determination of geometric altitude versus true altitude or pressure altitude, changing magnetic variation or outdated navaid declination, differences in "great circle" route calculations, survey errors, database resolution limitations, or other such factors can result in the defined path being slightly different than the desired path.. This difference between the desired path and the defined path is called the **path definition error.**

The aircraft elements of the navigation system estimate the aircraft's position and compares that position with the defined flight path. A deviation indication is produced which represents the calculated ~~perceived~~ displacement of the airplane from the defined ~~desired~~ flight path. This deviation is typically displayed on a primary flight display, or navigation displays, for flightcrew awareness, and is provided as an input to an autopilot and/or flight director system for command guidance or automatic control. Any resulting difference (i.e. non-zero deviation) between the estimated aircraft position from the desired flight path is called the **path steering error.** This error includes any display errors along with flight technical error.

Any error in the estimation of the aircraft's position is referred to as position estimation error, or **navigation system error**. ~~Any error introduced in the display of the deviation signal on the primary flight display is a display error. Navigation system error can include display errors.~~ The navigation system error may result in a displacement from the desired flight path.

The accuracy with which the aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or defined flight path position is called **flight technical error (FTE)**. FTE does not include human performance conceptual errors, typically which may be of large magnitude (e.g. entry of an incorrect waypoint or waypoint position, selection of an incorrect procedure, selection of an incorrect NAVAID frequency, or failure to select a proper flight guidance mode). FTE can be influenced by factors such as flightcrew response to guidance (e.g., response to Flight Director information), or external environment conditions such as a wind gradient or turbulence.

The sum of the path definition error, navigation system error ~~(including display error if applicable)~~ and the path steering error (i.e. flight technical error plus any display error) is the **total system error** (TSE), which is the difference between the desired flight path and the actual flight path. Figure 4.5-1 below shows the error terms considered in the cross-track dimension of the total system error.




**Navigation Lateral Error Components Related to RNP**
**Figure 4.5-1**

Particular levels of RNP can be satisfied using various NAVAIDs such as ILS and MLS, or by the use of a combination of navigation sensors (DME/DME, VOR/DME, IRU/IRS, GNSS, etc.) using a navigation computer (e.g., FMS). When a computed path (e.g., series of waypoints) is used as the basis for an approach operation, the desired flight path must typically be defined by a series of three dimensional earth based coordinates for the applicable waypoints or path definition points.

Approach or missed approach operations can be approved by demonstration of the capability to meet the required navigation performance (e.g., accuracy, integrity, availability) for a specific approach procedure, for a set of particular procedure types, or for a set of RNP levels.

The transition from typical en route or terminal RNP levels to an approach RNP level is accomplished by transitioning to the required RNP level for the approach in accordance with the approved instrument procedure or by a point no later than the final approach fix, if an aircraft is radar vectored to final (refer to AC 120-CNS).

Associated with the RNP level is a containment limit that is specified as "two times the level of RNP (2xRNP)". The system performance integrity provided by this RNP containment limit is intended to support its application as a basic element for either aircraft separation or obstacle or terrain clearance assessment. However, other considerations such as an obstacle rich environment, potential weather factors, high traffic density, limited communication or surveillance environment, or other such factors may also be appropriate to consider in determining if any additional airspace buffers may be appropriate, beyond the RNP containment limit. Similarly, operations at less than 2xRNP, may be found to be appropriate, such as if an ATS communication and surveillance environment otherwise safely permits ATS management of the airspace by other means than RNP containment (e.g., where ATS radar monitoring and radar vector separation on adjacent STAR transitions may be used to assure safe separation, in lieu of use of RNP containment).

**4.5.1. Standard RNP Levels.** The expression "RNP Level" is used to describe a specific value or level of required navigation performance. The term "RNP Level" may be interchangeably described as "RNP Type" in some industry and FAA references. However in this advisory circular, the term "RNP Level" is meant to apply only to a lateral RNP element (e.g., RNP .5) or to specific paired lateral and vertical elements (e.g., RNP .3/125'). The term "RNP Type" is generally reserved for future uses, in which future vertical and longitudinal elements or other conditions of RNP may additionally apply.

Standard values of RNP supporting initial, intermediate, or final approach segments, or missed approach segments are as specified in Table 4.5.1-1 below:

**Table 4.5.1-1.**
**STANDARD RNP LEVELS FOR APPROACH**

| RNP Level | Applicability/Operation (Approach segment) | Normal Performance (95%) | Containment Limit (**) |
|---|---|---|---|
| **RNP 1** | Initial/Intermediate approach | +/-1 nm | +/-2 nm |
| **RNP 0.5** | Initial/Intermediate/Final approach [Supports limited Category I minima)] | +/-0.5 nm | +/-1 nm |
| **RNP 0.3** | Initial/Intermediate/Final approach [Supports limited Category I minima] | +/-0.3 nm | +/-0.6 nm |
| **RNP 0.3/125'** | Initial/Intermediate/Final approach with specified baro vertical guidance[Supports limited Category I minima] | +/-0.3 nm<br>+/-125 ft | +/-0.6 nm<br>+/-250 ft |
| **RNP 0.03/45'** | Final approach with specified vertical guidance[Supports Category I minima] | +/-0.03 nm<br>+/-45 ft | +/-0.06 nm<br>+/-90 ft |
| **RNP 0.01/15'** | Final approach with specified vertical guidance [Supports Category I/II minima] | +/-0.01 nm<br>+/-15 ft | +/-0.02nm<br>+/-30 ft |
| **RNP 0.003/15'** | Final approach with specified vertical guidance [Supports Category I/II/III minima] | +/-0.003 nm<br>+/-15 ft (*) | +/-0.006 nm<br>+/-30 ft (*) |

**(*) Note:** Vertical accuracy does not apply below 100 feet HAT - below 100 feet HAT vertical performance is determined by applicable standards for touchdown performance.

**(**) Note:** For barometric VNAV, the obstacle assessment methodology described in Appendix 5 may be used to addresses vertical containment limits which consider multiple factors such as altimeter error, temperature, and "along track" fix error. Each of these factors should be considered, as necessary, in determining Required Obstacle Clearance (ROC). Nominal vertical values shown in this Table associated with various levels of RNP are intended to be used in conjunction with and considering factors described in Appendix 5, as applicable to the vertical path specified and the type or types of sensor systems used. For other forms of VNAV (e.g., when using an ECEF coordinate specified geometric path), assurance of vertical containment may be met by any FAA approved method, including the method specified by Appendix 5. Examples of acceptable methods other than that based on Appendix 5 would be methods where containment is considered as a "designed-in capability" of a system or aircraft (e.g., as for GBAS or SBAS), or a specific system/infrastructure/operational assessment method, acceptable to FAA, with potential corresponding operational or procedural requirements.

RNP is a required navigation performance level described by the specification of a numeric value indicating the required navigation accuracy for a specific operation, typically specified laterally in nautical miles - e.g., RNP 1 is a Required Navigation Performance of +/-1 nautical mile (95% Probability).

RNP containment is specified as RNP (X) x 2.

Standard RNP Levels are defined for lateral performance, or lateral and vertical performance, if applicable. Standard values for RNP for general use are as specified in RTCA's Minimum Airspace Performance Standards (MASPS) for RNP (RTCA DO-236) as amended, this advisory circular (AC120-29A) as amended, related Advisory Circulars, or as otherwise specified by FAA through published instrument procedures, the Aeronautical Information Manual (AIM), or by NOTAM. ICAO specified types or levels of RNP as promulgated in ICAO Manuals or ICAO Regional Supplements for International Airspace may also be considered as standard RNP levels.

Standard Levels of RNP typically used for various approach and missed approach segments supporting Category I procedures may be based on use of multi-sensor RNAV (e.g., FMS with IRS, VOR, DME, or GNSS inputs), or on other aircraft navigation systems having FMS like capabilities (e.g., GPS based navigation systems). Levels of RNP applicable to Category I may also take advantage of or also be based on sensor inputs received from specific landing systems (e.g., ILS, MLS, or GLS).

Standard Levels of RNP typically used for various approach and missed approach segments supporting Category II procedures may be based on the same capability specified above for Category I, except that for any portions of a final approach segment below 200' HAT for Category II, use of specific landing system sensors (e.g., ILS, MLS, or GLS) may be determined to be necessary to achieve the desired level of RNP. Similarly, for portions of any FAS below 200' HAT, use of a multi-sensor RNAV system should have suitable integrity and availability capability (e.g., may require use of multiple FMS with IRS, and suitable ILS, GNSS, or GBAS inputs to achieve the necessary RNP capability).

**4.5.2. Non-Standard RNP Levels or Types.** Non-Standard RNP Levels or Types may include RNP Levels or Types other than those specified in 4.2.5.

Examples of Non-Standard RNP Levels or Types may be those types specified by a particular Authority for specific applications (e.g., RNP 5 within certain geographic areas; RNP .15 for a particular air carrier "Special approach Procedure").

**4.6. Flight Path Definition.** Certain flight segments and waypoints are necessary to effectively implement approach and missed approach operations using landing systems where the required flight path is not inherent in the signal structure of the navigation aid (e.g., integrated multi-sensor area navigation systems and other RNAV systems such as satellite systems). The concepts and criteria described below may be applied to other types of navigation systems when using area navigation and RNP concepts.

In general, an operator must have an acceptable method to assure that any waypoints or path points which are considered critical to an instrument procedure (if any) are correctly defined, and are loaded into each applicable aircraft’s database, initially, and at each change cycle.

RNP based area navigation systems may use any leg types available and suitable for RNP path definition as specified by acceptable FAA or industry criteria (e.g., RTCA DO-236; ARINC 424 change (xx) for a particular type of navigation system), or leg types as otherwise approved by FAA for use with RNP. Leg types may be specified to define a suitable path in space in conjunction with established waypoints, new waypoints, or path definition points.

Levels of RNP may be specified for individual path segments, for an entire procedure, or for portions of a procedure (e.g., Intermediate segment, FAS, IMAS, or an entire missed approach path).

Levels of RNP may be procedurally specified, may be specified in a data base for automatic callup for an entire procedure when a procedure is loaded, may be specified in a data base for automatic callup for each leg or segment of a procedure, may be entered by the flight crew into the navigation system for a procedure or leg, or may be based on navigation system default settings if those default RNP settings are found to be acceptable to FAA (e.g., when using standard FMS RNP default values and standard instrument procedures with a compatible RNP level specified). When possible, it is recommended that RNP levels be specified by the instrument procedure, and automatically set for each applicable leg, to minimize flight crew input workload and potential for FMS or navigation system input error.

The following criteria and considerations are appropriate to specify the landing and rollout flight path. A graphic depiction of the points, heights, angles or other considerations described below is shown in Figure 4.6-1.

The approach segment connects with the rollout segments. An approach flight path is considered to terminate at the beginning of the rollout segment.

**Landing and Rollout Flight Path.** The following criteria specifies certain reference points and other criteria necessary to effectively implement landing and rollout operations using a landing system where the required flight path (e.g., FAS and RWS) is not inherent in the signal structure of the navigation aid (e.g., for satellite based sensor systems).

**Runway Datum Point (RDP).** The RDP is used in conjunction with the FPAP and the vector normal to the WGS-84 ellipsoid at the RDP to define the geodesic plane of a final instrument approach flight path to touchdown and rollout (e.g., FAS). It is a point typically at the designated center of the landing runway. An RDP is defined by a specified latitude, longitude, ellipsoidal height, and orthometric height. The RDP is a reference point used to connect the approach flight path with the runway. The RDP may or may not be coincident with, and need not necessarily be coincident with the designated runway threshold.

**Flight Path Alignment Point (FPAP).** The FPAP is a point, usually at or near the stop end of a runway, used in conjunction with the RDP and a vector normal to the WGS-84 ellipsoid at the RDP, to define the geodesic plane of a final approach and landing flight path (e.g., FAS and RWS). The FPAP typically may be the RDP for the reciprocal runway.

**Flight Path Control Point (FPCP).** The Flight Path Control Point (FPCP) is a calculated point located above the RDP in a direction normal to the WGS-84 ellipsoid. The FPCP is used to establish the vertical descent path and descent angle of the final approach flight path (e.g., FAS) to the landing runway.

**Datum Crossing Height [DCH].** The height of the Flight Path Control Point (FPCP) above the Runway Datum Point (RDP). Note: The FPCP may be specified in units of feet or meters, but is typically specified in units of feet.

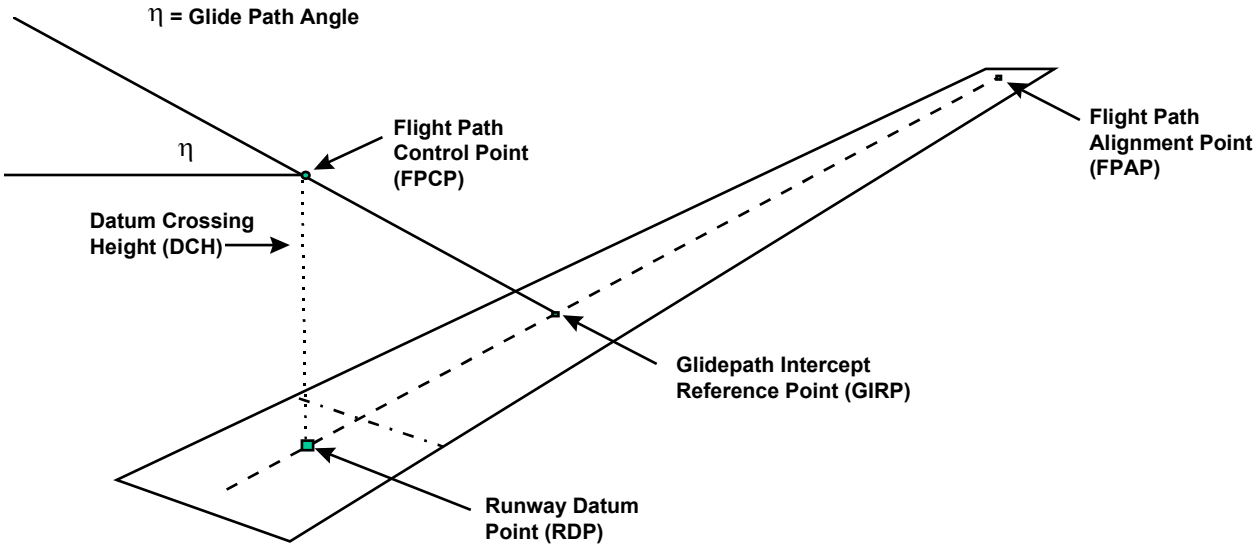
NOTE: A standard datum crossing height should typically be 50 ft. For sloped runway touchdown zones, a DCH in the range of 50 to 55 ft above the designated datum point is acceptable. Other values are accepted on a case by case basis considering the airport need for a different value, and the type of aircraft and operations to be used (e.g., STOL). Typically a DCH is coincident with the runway threshold (TCH). (Also see Sections 5.12.3 and 5.12.4).

**Glide Path Angle [GPA].** The glide path angle is an angle, defined at the FPCP, that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the RDP, FPAP, and a vector normal to the WGS-84 ellipsoid at the RDP). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the RDP and a plane perpendicular to that vector at the FPCP, respectively.

**Glidepath Intercept Reference Point [GIRP].** The GIRP is the point at which the extension of the final approach path (e.g., FAS) intercepts the runway.

**Points, Heights, Angles Or Other Considerations**
**For Definition of An Approach And Landing Flight Path**

**Figure 4.6-1**




***[ED Note: The above diagram is slightly misleading (Figure 4.6-1) and still needs to be fixed. The "local horizontal" line into the FPCP should appear to be parallel to the runway centerline plane(e.g., the runway centerline dashed line)]***

The locations established for, and the values assigned to, the **RDP, FPCP, DCH** and **GPA** will be selected based upon the operation need to establish the required **GIRP**. Operational considerations include:

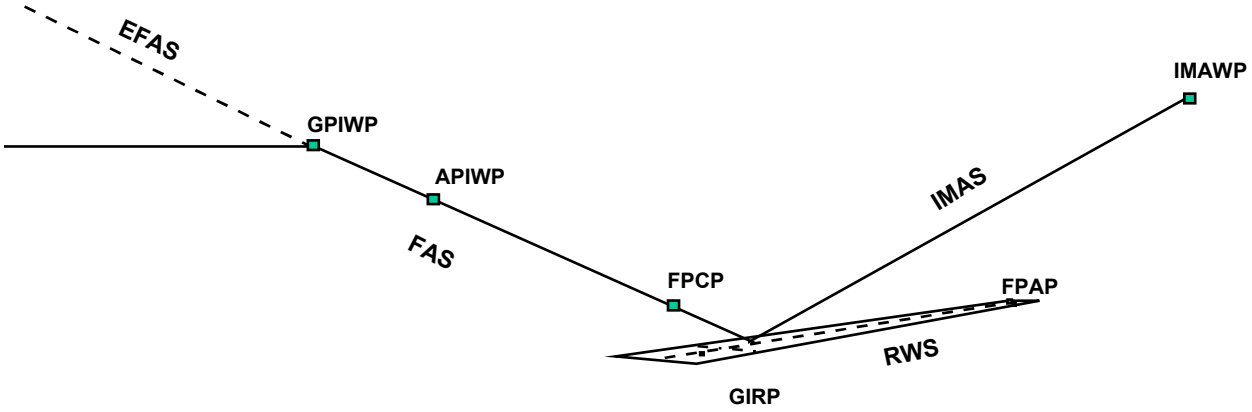
1) Path of wheels over threshold(s),
2) Need for coincidence with other aids and systems - visual and non-visual,
3) Runway characteristics (upslope and downslope, crown etc.),
4) Actual threshold, displaced threshold or multiple threshold characteristics,
5) Actual clearway or stopway characteristics

**Approach and Missed Approach Segments.** Figure 4.6-2 below shows the applicable reference points, path points, waypoints and leg types typically used to construct instrument approach procedures applicable to air carrier operations.

***[ED Note: The below diagram is incorrect (Figure 4.6-2) and still needs to be fixed. GIRP needs to be added into the Canvas file - Below it is shown, but it is only done so temporarily via a Word '97 insert, and its not actually part of the real Canvas diagram file. Also need to ADD an extension (dashed line segment) to show centerline guidance (extended RWS) beyond the FPAP]***

## Waypoint and Segment Placement

**Figure 4.6-2**




**Procedure Design Related Waypoint Definitions and Use.**

The following procedure design related waypoint definitions and uses are provided:

**Glide Path Intercept Waypoint (GPIWP)** - Glide Path Intercept Waypoint - The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in).

**Approach Intercept Waypoint (APIWP)** - Approach Intercept Waypoint - A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a Final Approach Segment (FAS) that is fixed in space (e.g., an xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway.

**Initial Missed Approach Waypoint (IMAWP)** - Initial Missed Approach Waypoint (Used only for MAP) - A Waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The IMAWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing.

**Procedure Design Related Segment Definitions.**

The following procedure design related segment definitions are provided:

| | |
|---|---|
| Final Approach Segment (FAS) | The segment of an approach extending from the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Glidepath Intercept Reference Point (GIRP). For the purpose of procedure construction, The Final Approach segment is defined as beginning at the FAF and ending at the Flight Path Control Point (FPCP) or point at which the missed approach segment starts (e.g., point of lowest nominal DA(H)). |
| Extended Final Approach Segment (EFAS) | That segment of an approach, co-linear with the Final Approach Segment, but which extends beyond the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP). |
| Runway Segment (RWS) | That segment of an approach from the glidepath intercept reference point (GIRP) to Flight Path Alignment Point (FPAP). |
| Initial Missed Approach Segment (IMAS) | That segment of an approach from the Glide Path Intercept Waypoint (GIRP) to the Initial Missed Approach Waypoint (IMAWP). |
| Missed Approach Segment (MAS) | That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated IMAWP, or missed approach holding WP, as specified for the procedure. |

## 5. AIRBORNE SYSTEM REQUIREMENTS.

**5.1. General.** The following accuracy, integrity and availability criteria are specified for aircraft systems intended for Category I or II. Aircraft related systems are addressed by 5.1.1, Non-aircraft systems (e.g., NAVAIDs) are addressed in 5.1.2, Specification of flight path is addressed in 5.1.3, such as is applicable to defining an RNAV LNAV or VNAV path to be followed by an aircraft, and specific airborne equipment requirements for Category I or II authorizations are addressed in 5.2 and 5.3.

**5.1.1. Airborne Systems.** Airworthiness criteria for aircraft systems intended to meet requirements of this AC are specified in paragraph 5.1.3 through 5.19 below, or Appendix 2 or 3 for demonstration of airborne systems for eligibility for Category I or II minima respectively.

For aircraft which completed an airworthiness demonstration applicable to Category I or II using earlier versions of this AC, or previous applicable ACs, new operational authorizations may be requested or may be continued only as provided for in standard OpSpecs.

**5.1.2. Non-Airborne Systems (e.g., Navaids or equivalent GNSS capability).** Unless otherwise specified by FAA, NAVAID/landing system characteristics to be used should have been addressed using an acceptable means of facility or capability classification (e.g., For a U.S. ILS facility, and example of a typical classification would be "II/E/2").

The classification should be specified in a manner suitable to address:

1) Intended navaid performance level (or an equivalent capability for GNSS),
2) Signal or capability coverage respect to the intended flight path(s) and runway, and
3) Navaid or capability "availability and integrity" (e.g., considering standby capability and power, as applicable).

This classification schema should at least be provided for any xLS capability (e.g., ILS, MLS or GLS). Typically this is done by use of FAA or ICAO criteria such as specified by FAA Order 6750.24 as amended, or ICAO Annex 10 Criteria, as suited to the applicable NAVAID facility or capability. Navaid facility or capability operational use is then predicated on suitable facility or capability classification respectively for ILS, MLS, or GLS (e.g., for ILS, III/E/2).

Navaid classifications or equivalent capability classification schema should be consistent among ILS, MLS or GLS to the maximum extent possible.

At non-U.S. facilities, consideration of equivalence to U.S. classification may be necessary for operational authorizations.

For GLS, classification schema are evolving and are expected to continue to do so as new GNSS elements or augmentation methods become operational. Nonetheless, an appropriate classification method equivalent to that used for ILS, or as otherwise specified by FAA or ICAO, should be used (e.g., addressing "Performance Level"/"Coverage"/"Integrity" such as "PL2/T/1").

Navaid facility or capability classification schema or associated airborne system documentation referring to that classification schema for ILS, MLS or GLS should not be defined or expressed in operational authorization terms (e.g., Category I, II or III xLS). This is necessary to recognize that operational authorization criteria for Category I, II or III may change in time, and because authorizations may not be unique to a particular navaid classification or capability, and further, may depend on and be a function of evolving airborne system elements, procedures, or other factors.

**5.1.3. Flight Path Specification.**

**5.1.3.1. Lateral.**

**Category I.** The following levels of lateral performance shown in Table 5.1.1-1 are acceptable for Category I, and corresponding minima may be applied. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.1-1.**
**CATEGORY I - LATERAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS) | [Minima equivalent to ILS at 200' HAT]<br><br>[Lateral tracking performance from 1000'HAT to 200' HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path, or equivalent; using at least 3 different representative facilities for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.] |
| 2) | "ILS Equivalent" (e.g., SCAT I/ MASPS;WAAS/MOPS) | [Minima equivalent to ILS at 200' HAT] |
| 3) | RNP<br>RNP ≤ .03<br><br>.03 <RNP< .3<br><br>RNP ≥ .3 | <br>[Minima equivalent to ILS at 200' HAT]<br><br>[Minima typically not lower than a DA(H) of 250' HAT]<br><br>[Minima restricted to not lower than a DA(H) of 250' HAT] |
| 4) | FMS (LNAV/VNAV or LNAV) | [Minima restricted to not lower than a DA(H) of 250' HAT] |
| 5) | RNAV (Op-Specs Part C; Para C063) | [Minima as specified by Standard OpSpecs/SIAP] |
| 6) | LOC, LOC BCRS,VOR, VOR/DME, NDB, ASR, PAR | [Minima as specified by Standard OpSpecs/SIAP] |

**Category II.** The following levels of lateral performance shown in Table 5.1.1-2 are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.1-2.**
**CATEGORY II - LATERAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS) | [Minima equivalent to ILS at 100' HAT]<br><br>See Category I Criteria to 300'HAT, and in addition,<br><br>[Lateral tracking performance from 300'HAT to 100' HAT within ±25microamps deviation from the indicated course or path, or equivalent, (for 95% of the time/per approach) using at least 3 representative facilities and for a minimum of 20 total approaches. System performance should be acceptable without undue oscillation.]*<br><br>* NOTE: Or using JAA ACJ AWO 231 Method |
| 2) | RNP<br>RNP ≤ .01 | <br>[Minima equivalent to ILS at 100' HAT] |

**Lateral Performance below or beyond DA(H).** For either Category I or II procedures with a DA(H) below 250'HAT*, when guidance is provided (e.g., for autoland, or HUD flare/rollout), the lateral performance should at least be equivalent to that attainable using an ILS Type I/E/1 localizer (or RNP .003) from 200' HAT, or 100' HAT as applicable, to the end of rollout.

***NOTE: This provision does not apply to systems intended for Category III - see AC120-28D for Category III requirements.**

From 200' HAT or 100' HAT, as applicable, until returning to an established missed approach segment of the approach procedure, if guidance is provided, performance should be at least equivalent to that attainable using an ILS Type I/E/1 localizer front and back course, or RNP.3 as applicable.

**5.1.3.2. Vertical.**

**Category I.** The following levels of vertical performance are acceptable for Category I, and corresponding minima may be applied. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.2-1.**
**CATEGORY I - VERTICAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS Glide Slope/Glide Path (any one xLS Glide Slope) | [Minima equivalent to ILS at 200' HAT]<br>[Vertical tracking performance from 700'HAT to 200' HAT should be stable without large deviations (i.e., within $\pm$75 microamps deviation) from the indicated path, or equivalent, using at least 3 different representative facilities and for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.] |
| 2) | "ILS Glide Slope Equivalent" (e.g., SCAT I/ MASPS; WAAS/MOPS) | [Minima equivalent to ILS at 200' HAT] |
| 3) | RNP<br>RNP $\leq$ .03 and ECEF** VNAV<br>.03 <RNP< .3 and BARO VNAV<br>RNP $\geq$ .3 with or without BARO VNAV | <br>[Minima equivalent to ILS at 200' HAT]<br>[Minima typically not lower than a DA(H) of 250' HAT]<br>[Minima restricted to not lower than a DA(H) of 250' HAT] |
| 4) | FMS BARO VNAV | [Minima restricted to not lower than a DA(H) of 250' HAT] |
| 5) | RNAV (Op-Specs Part C; Para C63, as amended) | [Vertical performance not applicable*] |
| 6) | LOC, LOC BCRS,VOR, VOR/DME, NDB, ASR, PAR | [Vertical performance not applicable*; except PAR minima equivalent to ILS] |

***[Ed Note: JE - in above table, still need to update and use the new Op-Spec References, equivalent to the old ones shown above - e.g., for C63]***

***Note: A procedure addressing a stabilized approach from the Final Approach Fix to MDA(H) is recommended for these procedures (except this note does not apply to PAR).**

****Note: ECEF VNAV - VNAV referenced to "Earth Center Earth Fixed Coordinates", or geometric height above the "earth reference surface" based VNAV.**

**Category II.** The following levels of vertical performance are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.2-2**
**CATEGORY II - VERTICAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS Glide Slope/Glide Path) | [Minima equivalent to ILS at 100' HAT]<br>See Category I Criteria to 300'HAT, and in addition,<br>[Vertical tracking performance from 300'HAT to 100' HAT within ±35** microamps deviation from the indicated course or path, or ±12 ft, which ever is greater, or equivalent, (for 95% of the time/per approach) using at least 3 different representative facilities and for a minimum of 20 total approaches. System performance should be acceptable without undue oscillation.]*<br>* NOTE: Or using JAA ACJ AWO 231 Method<br>** NOTE: When this provision is applied to path tracking in conjunction with Category III, momentary excursions up to ± 75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory. |
| 2) | RNP<br>RNP ≤ .01 with ECEF** VNAV | [Minima equivalent to ILS at 100' HAT] |

**Category I or Category II.**

**Vertical (VNAV) performance at altitude constraints prior to a Final Approach Fix (FAF) or Final Approach Point (FAP), or at a FAF or FAP.** For procedures with VNAV segment(s) prior to a FAF or FAP, at a FAF or FAP (e.g., intercepting a FAS from an en route segment, STAR, Profile Descent, initial approach or intermediate approach segment), vertical performance should normally be based on use of a vertical "Fly by" path rather than a "Fly over" path. The small vertical displacement which may occur (40' - 80' typically) at a vertical constraint as a result of using a vertical "Fly by" waypoint rather than vertical "Fly over" waypoint is considered operationally acceptable, and desirable, to assure asymptotic capture of a new (next) vertical segment. This applies to both "level off" or "altitude acquire" segments following a climb or descent, or vertical climb or descent segment initiation, or joining of climb or descent paths with different gradients.

> Note: A **"Fly By" vertical waypoint** is a WP for which an aircraft may initiate a vertical rate change and depart the specified vertical path to the active WP prior to reaching that WP, in order to asymptotically capture the next vertical path. A **"Fly Over" vertical waypoint** is a WP for which an aircraft must stay on the defined vertical path until passing the active WP, and may not initiate the necessary vertical rate change to capture the next vertical path until after passing the active WP. Hence, after passing the active WP, as the next WP becomes active, and if there is a vertical path change, then the aircraft must re-adjust vertical rate to re-capture the vertical path after having already overshot the first opportunity for an asymptotic capture of that new path.

**Vertical (VNAV) performance at waypoint altitude constraints near the point at which DA(H) or MDA(H) may occur.** For procedures with waypoints at or near the point at which DA(H) may occur, vertical (VNAV) performance should not preclude continuous descent of the aircraft to the runway, following the established VNAV path to the runway (e.g., VNAV should not initiate inappropriate capture of a missed approach segment and automatic level off (at MDA(H)) or initiation of MAP climb, without pilot confirmation that a missed approach or go-around is intended (e.g., TOGA initiation).

**Vertical (VNAV) performance below or beyond DA(H) or MDA(H).** For procedures with a DA(H) below 200' HAT* (e.g., for autoland, or HUD flare/rollout), the glide path/glide slope vertical performance should at least be equivalent to that attainable using an ILS glide slope at a facility classified as Type I/E/1, between 200' HAT and 50' HAT.

***NOTE: This provision does not apply to systems intended for Category III - see AC120-28D for Category III requirements.**

**5.1.3.3. Longitudinal.** Longitudinal (along track) requirements for Category I or II operations are as specified below.

**Category I.** The following longitudinal (along track) requirements are acceptable for Category I. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.3-1**
**CATEGORY I - LONGITUDINAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS, or any combination provided by MMR) | |
| | Use of VHF OM/MM Marker Beacons | [Minima equivalent to ILS at 200' HAT] |
| | Use of VOR/TACAN Fixes (other than for MM) | [Minima equivalent to ILS at 200' HAT] |
| | Use of LOM/LMM NDBs | [Minima equivalent to ILS at 200' HAT] |
| | Use of suitable DME Distance Information | [Minima equivalent to ILS at 200' HAT] |
| | Use of FMS RNAV Fixes (other than for MM) | [Minima equivalent to ILS at 200' HAT] |
| | Use of Distance to "Runway Threshold WP" | [Minima equivalent to ILS at 200' HAT] |
| | Other methods (e.g., Radar fixes, Fan Markers) | [Restricted minima may apply - DA(H)≥250' HAT] |
| | No specific method of assuring along track position | [Restricted minima may apply - DA(H)≥250' HAT] |
| 2) | "ILS Equivalent" (e.g., SCATI/MASPS;WAAS/MOPS) | [Same as for ILS/MLS/GLS described above |
| 3) | RNP* | |
| | RNP ≤ .03 | [Minima equivalent to ILS at 200' HAT] |
| | .03 <RNP< .3 | [Minima typically not lower than a DA(H) of 250' HAT] |
| | RNP ≥ .3 | [Minima restricted to not lower than a DA(H) of 250' HAT] |
| | | *Note: RNP Systems/Procedures that do not provide for display of distance to a "Runway Threshold WP" may have minima additionally restricted. |
| 4) | FMS (LNAV/VNAV or LNAV) | [Minima restricted to not lower than a DA(H) of 250' HAT] |
| 5) | RNAV (Op-Specs Part C; Para C63) | [Minima as specified by Standard Op-Specs/SIAP] |
| 6) | LOC, LOC BCRS,VOR, VOR/DME, NDB, ASR, PAR | [Minima as specified by Standard Op-Specs/SIAP] |

**Category II.** The following levels of longitudinal (along track) performance are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.3-2**
**CAT II - LONGITUDINAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS, or any combination provided by MMR) | Same as for Category I, except that an IM or suitable distance readout to a "Runway Threshold WP" is also required. |
| 2) | RNP<br>RNP ≤ .01 | [Same as for ILS/MLS/GLS above.] |

**5.1.3.4 Typical Wind and Wind Gradient Disturbance Environment.** The lateral and vertical performance described in sections of 5.1.3 above should typically be expected to be achievable in conditions at least as described below. Performance

may be estimated, assessed analytically, demonstrated in simulation, or demonstrated in flight. Relevant associated information on demonstrated winds encountered or estimated wind gradient capability may be included in the AFM, as desired by the applicant.

Systems intended for use with procedures for either Category I or Category II should be capable of coping with at least the following wind, wind gradient, and turbulence conditions:

Reported Surface Headwind Component - 25 kts
Reported Surface Tailwind Component - 10 kts
Reported Surface Crosswind Component - 15 kts

Wind Gradients/Shear - at least 4 kts per 100' from 500' HAT to the surface;

Recommended Capability - Ability to cope with 8 kts per 100' for 500', moderate turbulence, knife edge shears of at least 15kts over 100', 20 kts lateral directional vector shears of 90 deg over 100', and ability to cope with a 20 kt logarithmic shears between 200' and the surface.

**5.2. Airborne Equipment for Category I.** The following equipment (along with any additional equipment specified by 14 CFR for IFR flight) is the minimum aircraft equipment considered necessary for an authorization for Category I.

1) For ILS, GLS, or MLS approach capability:

- 2 navigation receivers, or equivalent type of device, of each type intended for use,

  Note 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR),

  Note 2: For GLS, at least one data link receiver capable of receiving GBAS uplinked corrections for GNSS position fix correction data may be considered to be acceptable, when used with dual navigation receiver capability (e.g., dual GPSSU sensors) receiving GPS SV ranging information. Dual data link receivers capable of receiving GBAS uplinked corrections for GNSS are recommended.

  Note 3: Installation of only one navigation receiver may be authorized by FAA for special circumstances, considering the particular facilities and routes to be used, such as if suitable minima restrictions and requirements for alternate navigation capability are applied (e.g., 1 GLS receiver if two ILS receivers are installed).

- Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see Section 5.9 for details),

- Suitable failure annunciation visible to each pilot,

- 1 or more Marker Beacon systems (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates),

- 1 or more DMEs (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates).

- 1 or more ADFs (unless an approved RNAV substitute system is available, or unless ADF is not required for the intended route of flight, including alternates). Note 2 ADFs may be required in accordance with section 121.549 for certain international operations, and for certain obstacle or terrain critical departure, approach, or missed approach procedures.

- For aircraft intended for approval of landing minima below RVR3000, at least one flight director or one autopilot,

- It is recommended that the following capability be available:
  Radar Altimeter,
  Standby power for at least one pilot's ILS/GLS nav receiver and displays,
  Rain removal capability.

2) For approaches other than ILS, GLS, or MLS (e.g., RNAV, VOR, VOR/DME, NDB).

- 2 navigation receivers and associated displays of the type of the approach system to be used (unless otherwise authorized by FAA for the facilities and route to be used), or

- 2 FMS systems (unless use of 1 is authorized by FAA for the facilities and route to be used) which are capable of using the necessary NAVAIDs or equivalent (e.g., space vehicles (SVs)), or which can be monitored by using raw data NAVAID data (e.g., on an associated ND display or RDMI).

- Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see Section 5.9 for details)

- Suitable failure annunciation visible to each pilot

- For ASR or PAR, at least 2 com radios capable of receiving communications of ASR or PAR information.

- It is recommended that the following capability be available: Radar Altimeter, standby power for at least one pilot's VOR or RNAV nav receiver and displays, rain removal capability.

3) For aircraft types and systems approved previously to issuance of this AC using earlier AC120-29A or equivalent criteria, the aircraft must have a system which meets that earlier criteria. While such systems may continue to be produced and installed for retrofit in aircraft, or may continue to be installed in new production aircraft or variants, or future derivatives of those types or variants, any additional credit permitted by this AC for Category I capability may be limited to those aircraft and systems meeting revised provisions of this AC, including those provisions shown in Appendix 2.

4) For requirements related to equipment inoperative dispatch pertaining to Category I approach capability see Section 5.22 below. For situations involving in-flight failure of equipment pertaining to Category I approach capability see Section 5.23 below.

***[Ed Note: Still need to put above the above requirements in "Table Form", for convenience to the reader, time permitting, and if at all possible]***

**5.3. Airborne Equipment for Category II.** The following equipment (along with any applicable equipment otherwise specified above for Category I) is the minimum aircraft equipment considered necessary for an authorization for Category II.

1. - 2 independent navigation receivers, or equivalent, of each type intended for use,

Note 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR),

Note 2: For GLS, at least one data link receiver capable of receiving GBAS uplinked corrections for GNSS position fix correction data may be considered to be acceptable, when used with dual navigation receiver capability (e.g., dual GPSSU sensors) receiving GPS SV ranging information. Dual data link receivers capable of receiving GBAS uplinked corrections for GNSS are recommended.

2. A suitable Automatic Flight Control System, or manual flight guidance system, or both (e.g., flight director) as follows:

- A system or systems designed to meet criteria of Appendix 3, or

- For aircraft types and systems approved previously to issuance of this AC using earlier AC120-29A or equivalent criteria, the aircraft must have a system which meets that earlier criteria. While such systems may continue to be produced and installed for retrofit in aircraft, or may continue to be installed in new production aircraft or variants, or future derivatives of those types or variants, any additional credit permitted by this AC for Category II capability may be limited to those aircraft and systems meeting revised provisions of this AC, including those provisions shown in Appendix 3.

- At least 1 autopilot (AFGS) and at least dual flight director systems with an independent display for each pilot is recommended. Dual systems which provide the same information to both pilots, with the second system in "hot standby status" may be acceptable only if suitable comparison monitoring between the systems is available, and timely transfer to standby can be completed, and suitable annunciation to the flightcrew is provided.

3. A radar altimeter display for each pilot. (Note: At least 2 independent radar altimeters with a display for each pilot are recommended.)

4. Rain removal equipment is required for each pilot (e.g., windshield wiper, bleed air). (Note: hydrophobic coating is recommended for each applicable forward windshield, in lieu of rain repellent, due to environmental considerations.)

5. Flight instruments and annunciations which can reliably depict relevant aspects of the aircraft position relative to the approach path, attitude, altitude and speed, and aid in detecting and alerting the pilots in a timely manner to failures, abnormal lateral or vertical displacements during an approach, or excessive lateral deviation (see Section 5.9 for details).

6. Unless otherwise approved by FAA based on demonstration of acceptable pilot workload, an autothrottle system should be provided.

For requirements related to equipment inoperative dispatch pertaining to Category II approach capability see Section 5.22 below. For situations involving in-flight failure of equipment pertaining to Category II approach capability see Section 5.23 below.

***[Ed Note: Put above reqts in Table Form, if possible]***

**5.3.1. Standard Category II Minima.** Standard Category II minima are a DA(H) of 100' HAT and RVR not less than 1200 feet (350m).

**5.3.2. Special Category II Authorizations.** Special Category II minima may be authorized for certain qualifying ILS/GLS facilities (e.g., Type I ILS). Minima at these facilities may be restricted as follows depending on NAVAID, airport facility, and obstacle assessments by FAA. FAA Order 8400.13 addresses certain standard provisions applicable to these authorizations. Other provisions may apply when proposed by the applicant, and approved by FAA. Any authorizations issued should be consistent with one or more of the following DA(H) and RVR paired provisions.

DA(H) 150' HAT RVR 1800

DA(H) 150' HAT RVR 1600

DA(H) 100'HAT RVR 1800

DA(H) 100' HAT RVR 1600

DA(H) 100'HAT RVR 1200

**5.4. Automatic Flight Control Systems and Automatic Landing Systems.** Automatic Flight Control Systems, Autoland Systems, or Manual Flight Guidance systems (e.g., HUD) are considered acceptable for use and are recommended for Category I or II ILS, MLS, or GLS procedures which do not have NOTAM restrictions on localizer or glide slope or equivalent signals (e.g., Glide Slope unusable below 500'HAT, or Localizer unusable inside threshold).

**5.5. Flight Director Systems.** Characteristics of Flight Director Systems (head down or head up) used for aircraft authorized for Category I or II should be compatible with any characteristics of autopilot or autoland system used. Flight control systems which provide both autopilot control and flight director information may display, or may not display, flight director commands as appropriate for the system design and operator requirements. Regardless of whether Flight Director commands are provided, situational information displays of navigation displacement must also be provided to both flight crewmembers. To assure that unacceptable deviations and failures can be detected, the displays must be appropriately scaled and readily understandable in the modes or configurations applicable.

**5.6. Head-up Display Systems.** Head-up Display systems used as the basis for a suitable Category I or II authorizations must provide guidance for one or both pilots as appropriate for the system design. If information is provided to only the flying pilot, then appropriate monitoring capability must be established for the non-flying pilot. Monitoring tasks must be identified, and the non-flying pilot must be able to assume control of the aircraft in the event of system failure or incapacitation of the pilot using the HUD (e.g., for a safe go-around or completion of rollout). Head-up Display Systems acceptable for Category I or II must meet provisions of Appendix 2 or 3 respectively, or acceptable earlier criteria specified by the FAA and referenced in an AFM.

**5.7. Enhanced/Synthetic Vision Systems.** Enhanced/Synthetic Vision Systems based on millimeter wave radar or other such sensors may be used to assure the integrity of other flight guidance or control systems in use during Category I or II operations. They must be demonstrated to be acceptable to FAA in a proof of concept evaluation and they must otherwise meet the requirements of Appendix 2 or 3 of this AC as applicable. Use of Enhanced/Synthetic Vision Systems for purposes other than establishing the accuracy or integrity of flight guidance system performance must be demonstrated to be acceptable through proof of concept testing prior to identification of specific airworthiness and operation criteria.

**5.8. Hybrid Systems.** Hybrid systems (e.g., a fail passive autoland system used in combination with a monitored HUD flight guidance system) may be acceptable for Category I or II if the system provides the equivalent performance and safety to a non-hybrid system as specified for the minima sought (e.g., Category I or II).

Hybrid systems with automatic landing capability should be based on the concept of use of the automatic landing system as the primary means of control, with the manual flight guidance system serving as a backup mode or reversionary mode.

Any transition between hybrid system elements (e.g., control transition from autoland use to manual control HUD use, or for response to failures) must be acceptable for use by properly qualified flightcrews (e.g., qualified in accordance with Part 121, an approved Advanced Qualification Program (AQP), or equivalent JAA criteria, as applicable, and standard industry practices). Transitions should not require extraordinary skill, training, or proficiency.

For any system which requires a pilot to initiate manual control at or shortly after touchdown, the transition from automatic control prior to touchdown to manual control using the remaining element of the hybrid system (e.g., HUD) after touchdown must be shown to be safe and reliable.

**5.9. Instruments, Systems, and Displays.** The following identifies Flight Instrument, Systems, and Display presentations requirements for Category I and Category II operations:

**5.9.1 Instruments, Systems, and Displays for Category I.**

1) Attitude indicators, EADI's or primary flight displays must be provided for each required pilot (PF and PNF), or equivalent electro-mechanical instruments depicting attitude, barometric altitude, airspeed, and vertical speed.

2) HSIs, EHSIs, NDs or other equivalent navigation displays, with pertinent, reliable and readily understandable lateral situation information for both normal and non-normal conditions related to Category I landing and missed approach procedures, must be provided for each required pilot.

3) Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed altitude scales).

4) The location and placement of situation information/navigation displays must be appropriate for each required flight crewmember, and must be appropriately scaled and readily understandable in presentations or mode of display used.

5) Suitable redundant lateral, and where applicable, vertical path displacement information from the final approach course and specified glide path must be provided.

For any operation intended for use with a DA(H) below 250' HAT, lateral and vertical displacement information must be provided on the PFD, EADI, ADI or equivalent to each pilot independently.

For RNP operations with minima below 250' HAT, the lateral and vertical displacement full-scale indication on the PFD, EADI, or attitude indicator should be as shown in Figure 5.9.2-1, unless otherwise approved by the FAA. It is recommended that these displacement indications be provided for any RNP approach operations. Figure 5.9.2-1 shows that for the point on the approach path where the RNP portion of the path meets the angular portion of display limits, the display limit distance from nominal path (zero deviation) to full scale high or to full scale low display deviation is $\pm$ 250' (vertical displacement), and $\pm$ 1 x RNP (lateral displacement). At the point on the approach path where the angular display limit converges to a constant value (i.e. nominal path is at 100' HAT), the full scale displacement is 48' from full scale high to full scale low (vertical displacement), and 300' from full scale left to full scale right (lateral displacement).

6) Decision Altitude (Height) or Minimum Descent Altitude (Height) advisory indications that are readily understandable and appropriately distinctive plus marker beacon indications (middle marker, and outer marker), or equivalent, should be provided at each required pilot station.

> **NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flight deck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."**

7) Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided.

8) Automatic audio call-outs as described in paragraph 5.11 are recommended.

9) A suitable rain removal method is recommended for each pilot for Category I operations. Suitable methods typically include windshield wipers, bleed air windshield rain removal, or hydrophobic coatings.

**5.9.2 Instruments, Systems, and Displays for Category II**.

1) Attitude indicators, EADI's or primary flight displays must be provided for each required pilot (PF and PNF), or equivalent electro-mechanical instruments depicting attitude, barometric altitude, airspeed, and vertical speed plus suitable standby attitude information available to each required pilot.

2) HSIs, EHSIs, NDs or other equivalent navigation displays with pertinent, reliable and readily understandable lateral situation information for both normal and non-normal conditions related to Category II landing and missed approach procedures, must be provided for each required pilot.

3) Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed altitude scales).

4) The location and placement of situation information/navigation displays must be appropriate for each required flight crewmember, and must be appropriately scaled and readily understandable in presentations or mode of display used.

5) Suitable redundant lateral and vertical path displacement information from the final approach course and specified glide path must be provided.

Lateral and vertical displacement information must be provided on the PFD, EADI, ADI or equivalent to each pilot independently.

Lateral displacement expanded scale information must be provided to confirm that the aircraft position with respect to intended flight path and the landing runway on each PFD, EADI, ADI or equivalent (e.g., for ILS, a full scale sensitivity of 1 Dot (0.0775 ddm)), or the following criteria applicable to RNP.

For RNP operations, the lateral and vertical displacement full-scale indication on the PFD, EADI, or attitude indicator should be as shown in Figure 5.9.2-1, unless otherwise approved by FAA. It is recommended that these displacement indications be provided for any RNP approach operations. Figure 5.9.2-1 shows that for the point on the approach path where the RNP portion of the path meets the angular portion of display limits, the display limit distance from nominal path (zero deviation) to full scale high or to full scale low display deviation is $\pm$ 250' (vertical displacement), and $\pm$ 1 x RNP (lateral displacement). At the point on the approach path where the angular display limit converges to a constant value (i.e. nominal path is at 100' HAT), the full scale displacement is 48' from full scale high to full scale low (vertical displacement), and 300' from full scale left to full scale right (lateral displacement).

6) An autopilot or flight director system suitable for the minima to be authorized.

7) Unless otherwise approved by the FAA for Category II operations based on autopilot use alone, flight director(s), or command guidance information, should be provided for each pilot, suitable for the minima to be authorized - at least dual independent system capability must be installed for Category II operations for aircraft which are certificated with more than one required pilot.

> NOTE: For Head Up Display (HUD) operations, availability of the information in items 1, 2 and 5 above on a HUD does not necessarily substitute for availability of this information on pertinent head-down displays (HDDs). Configurations found acceptable to FAA include use of a compatible HUD and HDDs at the Crewmember 1 (CM1/Captain) flight deck station, and suitable and comparable HDDs at the Crewmember 2 (CM2 /FO) flight deck station, each with adequate flight path display and failure annunciation. Use of other HUD/HDD configurations for CM1 and CM2 must be evaluated by FAA, and be determined to provide acceptable and equivalent or better capability.

8) Unless otherwise approved by FAA based on demonstration of acceptable pilot workload, an autothrottle system should be provided.

9) Decision Altitude (Height) advisory indications that are readily understandable and appropriately distinctive plus a display of radio altitude and marker beacon indications (inner marker, middle marker, and outer marker), or equivalent, should be provided at each required pilot station.

> **NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flight deck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."**

10) Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided.

11) Automatic audio call-outs as described in paragraph 5.11 are recommended.

12) A suitable rain removal method is required for each pilot for Category II operations.

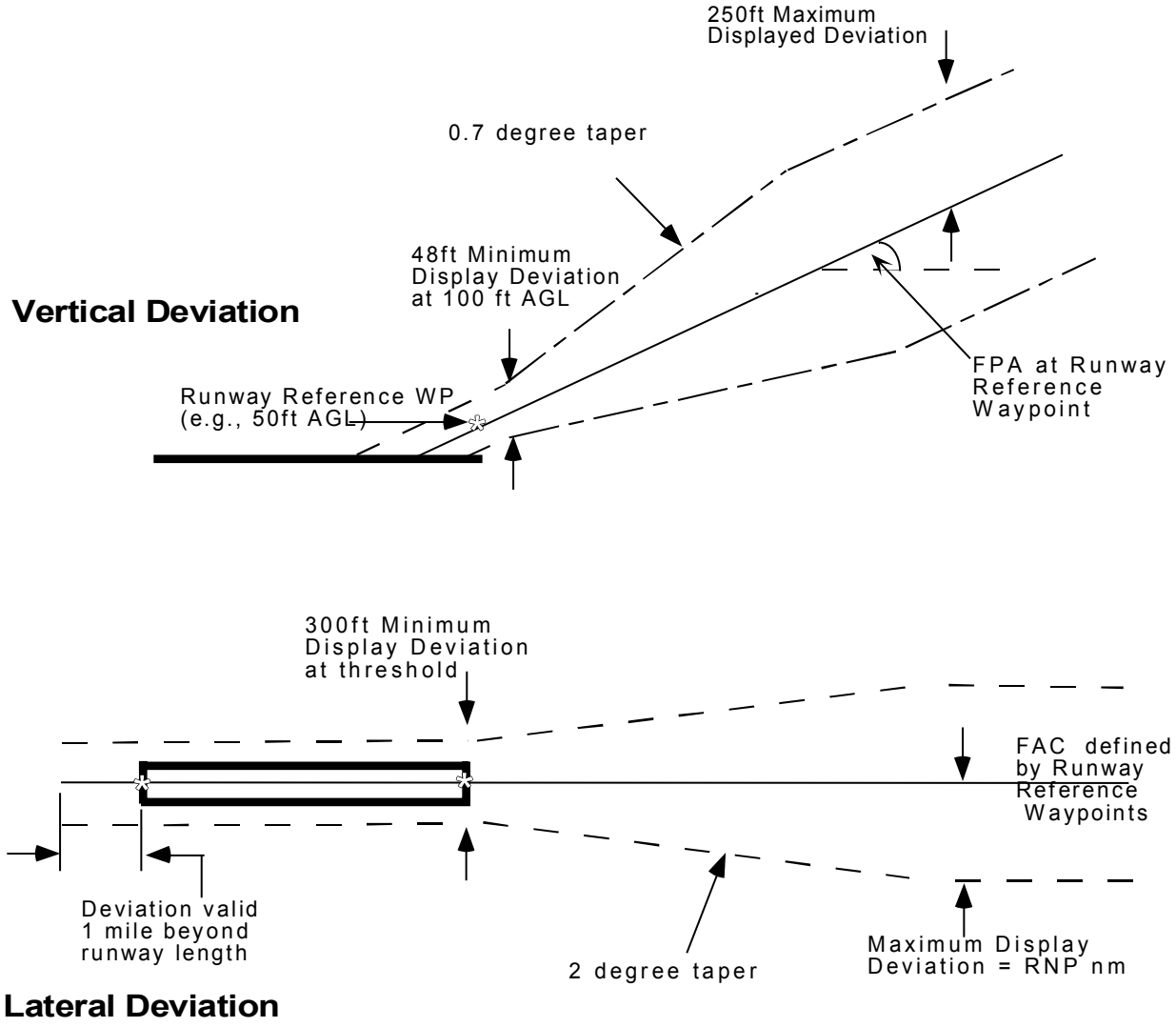
13) A demonstration of the suitability of any indications for non-normal configurations for which credit is sought (e.g., electrical configurations, hydraulic power).

**Figure 5.9.2-1**

***[ED NOTE: Incorrect Fig # below - in Canvas file - JRA assistance? - Also, see comment "Main Fig 5.9.1-1 for a suggestion on showing both deviations as ± half scale. I concur with the comment, but can't easily change the Canvas figure file.]***

**Figure 5.9.1-1**

**LATERAL AND VERTICAL PATH DISPLACEMENT**
**FULL SCALE INDICATIONS FOR RNP BASED SYSTEMS**




**5.10. Annunciations.** Annunciations must be clear, unambiguous, and appropriately related to the flight control mode in use. The mode annunciation labels should not be identified by landing minima classification. For example, APPROACH, LAND

2, LAND 3, Single Land, Dual Land, are acceptable mode annunciation labels, whereas, "Category II", "Category III", etc., should not be used. Aircraft previously demonstrated for Category I or II which do not meet this criteria may require additional operational constraints to assure the correct use of minima suited to the aircraft configuration.

**5.11. Auto Aural Alerts.** Automatic Aural Alerts (automatic call-outs, voice callouts, etc.) of radar altitude, or call-outs approaching landing minimums, or call-outs denoting landing minimums are recommended and should be consistent with the design philosophy of the aircraft in question. However, any automatic call-outs used should not be of a volume or frequency that interferes with necessary flightcrew communications or normal crew coordination procedures. Recommended automatic call-outs include a suitable alert or tone as follows:

1. At 500 feet (radar altitude), approaching minimums and at minimums, and

2. Altitude call-outs during flare, such as at "50" feet, "30" feet and "10" feet, or altitudes appropriate to aircraft flare characteristics.

Low altitude radio altitude call-outs, if used, should appropriately address the situation of higher than normal sink rate during flare, or an extended flare which may be progressing beyond the touchdown zone. Other alerts may be used when approved by the Administrator, if those alerts are consistent with that operators approved procedures and minima, and do not impair crew communication.

**5.12. Navigation Sensors**

Navigation sensors as noted in Sections 4.3.7.1 through 4.3.7.4 and in 5.12.1 or 5.12.2 below may be used to support Category I or Category II Instrument Approach Procedures.

Navigation systems, procedures, sensors or navaid signals cited in paragraphs 4.3.7.1 through 4.3.7.4 or in 5.12.1 or 5.12.2 may also use and take suitable credit for various forms of inertial or air data system capability when combined with capability of the sensors cited in the above provisions to improve accuracy, integrity, or availability performance (e.g., position or velocity complementary filtering, or Kalman filtering may be used, and appropriate credit taken for performance improvement).

**5.12.1 Navigation Sensors for (xLS) - ILS, GLS, or MLS.** For ILS, GLS, or MLS various navigation sensors individually may be acceptable to support Category I or II operations. ILS localizer and glideslope signals are the primary means currently used for the determination of deviation from the desired path for lowest Category I or II operations. Criteria for acceptable ILS and MLS localizer and glide-slope receivers are included in Appendix 2 or 3 or in earlier acceptable criteria used by FAA for previous demonstrations of systems for Category I or II.

Other navigation sensors, such as GNSS, or DGNSS, may be used individually or in combination to satisfy the necessary accuracy, integrity and availability for Category I or II. Navigation sensors other than ILS must meet equivalent ILS performance or appropriate RTCA or EUROCAE criteria for lowest Category I minima credit, unless otherwise authorized.

Appropriate marker beacon information, or equivalent, must be displayed to each pilot for the outer, middle and inner markers. The FAA may authorize appropriate substitutes for marker beacons for Category I or II based upon the use of suitable GNSS/DGNSS capabilities, or DME.

ADF capability, or equivalent capability, should be available as suitable for the planned route of flight or planned alternates (e.g., FAR 91.205 (d)(2) and FAR 121.349). For example, at least 1 ADF should be available for ILS procedures, unless the operator does not use ILS procedures with an NDB facility identified as an approach transition or missed approach navaid, or if the operator has available and uses an approved RNAV capability providing equivalent or better performance to that provided by ADF/NDB. RNP qualified aircraft may be considered to be eligible for ADF/NDB waypoint substitution any time the area navigation system (e.g., FMS) is able to provide RNP.3 or better capability, for each applicable equivalent procedure segment, or for use of an equivalent NDB waypoint. Any other RNAV capability substitution for use of ADF/NDB for instrument procedures should be as determined to be acceptable for that operator by the CMO (e.g., GNSS system substitution in accordance with AIM provisions).

Note: PAR may also be considered to be acceptable for Category I (also see 4.3.4.1.c and 4.3.8.g).

**5.12.2 Navigation Sensors for Approaches other than ILS, GLS, or MLS.** For approaches other than ILS, GLS, or MLS, the following sensors are considered to be acceptable for providing course guidance for Category I Operations (Note: Category II operations are not authorized exclusively using these sensors.):

- LOC
- LDA
- SDF
- BCRS
- RNAV (e.g., FMS)
- GPS
- VOR
- VOR/DME
- TACAN
- NDB
- NDB/DME
- Dual NDB
- ASR
- KRM (RMS)

**5.12.3 Aircraft Navigation reference points, Wheel to Eye Height, and Wheel to Nav Reference Point Height**

To assure suitable wheel height and clearance over the threshold of runways when following an electronic path (e.g., glideslope or VNAV) and when using visual references (e.g., VASI/PAPI) aircraft manuals should specify and operators should be aware of the height of the pilots eye reference point and the height of the navigation reference point (e.g., glideslope antenna) above the wheel path during landing. This is usually specific to each aircraft type. This information should be available to the operator and pilot, along with any guidance on the minimum acceptable runway threshold crossing height criteria for procedures, if applicable, and any constraints or recommendations for proper VASI/PAPI use.

**5.12.4 Threshold Crossing height**

Typically procedures are designated with vertical path runway threshold crossing height in the range of 50 to 55 ft. Unless otherwise accepted by FAA, aircraft should be able to use these standard facilities and any other facilities with a vertical path (glideslope or VNAV path) having a threshold crossing height specified as not less than 48'.

For operations on facilities where a threshold crossing height (glideslope or VNAV) is less than 48', the operator and CHDO should consider the advisability of those operations on a case by case basis. Considerations should include any obstructions in the pre-threshold area, the amount the glideslope or VNAV path is below standard values, aircraft type and aircraft characteristics as proposed for the operation, whether the runway under-run area is a full load-bearing surface, placement of lighting aids (threshold lights/approach lights, availability and suitability of VASI/PAPI, weather minima to be used, and any other relevant factors.

**5.13. Supporting Systems and Capabilities.**

**5.13.1. Flight Deck Visibility.** Suitable forward and side flight deck visibility for each pilot should be provided as follows:

a. The aircraft should have a suitable visual reference cockpit cutoff angle over the nose for the intended operations, at the intended approach speeds, and for the intended aircraft configurations, as applicable (e.g., flap settings),

b. The aircraft's flight deck forward and side windows should provide suitable visibility for taxi and ground operations in low visibility, and

c. Placement of any devices or structure in the pilot's visual field which could significantly affect the pilot's view for low visibility operations must be acceptable (e.g., HUD drive electronics, sunvisor function or mountings).

**5.13.2. Rain and Ice Removal.** Suitable windshield rain removal, ice protection, or defog capability should be provided as specified below:

a. Installation of rain removal capability is recommended for Category I and required for Category II (e.g., windshield wipers, windshield bleed air).

b. Installation of use of windshield hydrophobic coatings, or use of equivalent rain repellent systems which meet pertinent environmental standards are recommended.

c. Installation of windshield anti-ice or de-ice capability is recommended for Category I and required for Category II for aircraft intended to operate in known icing conditions during approach and landing.

d. Installation of at least forward windshield defog capability is recommended for aircraft subject to obscuration of the pilot's view during humid conditions.

Aircraft subject to obscuration of the windshield due to rain, ice, or fogging of the pilot's view which do not have protection, or which do not have adequate protection may require operational limitations on the conditions in which low visibility operations are conducted.

**5.13.3. Miscellaneous Systems.** Other supporting systems including instruments, radar altimeters, air data computers, inertial reference units, instrument switching, or capabilities such as flight deck night lighting, landing lights and taxi lights, position, turnoff, and recognition lights, flight data recorders, cockpit voice recorders or other low visibility related aircraft systems must meet any appropriate criteria as specified in Appendix 2 or 3, in basic airworthiness requirements applicable to U.S. certificated aircraft or equivalent, or acceptable earlier criteria authorized by FAA for aircraft previously demonstrated to be acceptable for Category I or Category II operation (See sections 5.20. and 5.21. for GPWS, EGPWS and FDR provisions).

**5.14. Go-Around Capability.** For aircraft authorized for instrument approaches, and particularly for aircraft intended for operation to Category II minima, evaluation of go-around capability should be based on both normal and any specified non-normal operations, down to the lowest minima expected. Assessment should account for factors related to aircraft geometric limitations (e.g., body attitude and potential for tail strike) during the transition to go around, limited visual cues, autoflight system mode switching if applicable, and any other pertinent factors identified by FAA. For aircraft in which a go-around from a very low altitude may result in an inadvertent touchdown, the safety of such a procedure should be established considering its effect on related systems, such as operation of autospoilers, automatic braking systems, autopilot/flight director mode switching, autothrottle operation and mode switching, reverse thrust initiation and other systems associated with, or affected by, a low altitude go-around.

If an automatic or flight director go-around capability is provided, it should be demonstrated that a go-around can be safely initiated and completed from any altitude to touchdown. If an automatic go-around mode can be engaged at or after touchdown, it should be shown to be safe. The ability to initiate an automatic or flight director go-around at or after

touchdown is not required or appropriate. Inadvertent selection of go-around after touchdown (either an automatic or flight director go-around capability) should have no adverse effect on the ability of the aircraft to safely rollout and stop.

Regardless of the flight guidance system used, availability of appropriate information to safely go-around should be available to the flight crew, and the aircraft should have the capability to go-around. The go-around must be able to be initiated at any time during the approach to touchdown. Although flight guidance system go-around capability is not required, if such go-around capability is supported by a flight guidance system, that capability should be able to be selected at any time during the approach to touchdown. If a go-around mode of a flight guidance system is activated at a low altitude where the aircraft inadvertently touches the ground, the flight crew should be have access to adequate information to accomplish a safe go around, and the aircraft or flight guidance system should not exhibit any unsafe characteristic as a result of an inadvertent touchdown.

The following factors should typically be considered when evaluating the safety of go-arounds from any point in the approach before touchdown:

1) Go-around capability should address normal operating conditions, and may include specified non-normal conditions (e.g., engine out) down to the lowest expected operating minimum.

2) Factors related to any geometric limitations (such as tail strike) or configuration changes (such as flap retraction, or allowing for any necessary acceleration segment) of the aircraft during the transition to a go-around should be considered.

3) Factors such as the autopilot, flight director, or autothrottle mode switching or automatic disconnect, minimizing altitude loss during transition to a go-around, and addressing any adverse consequences that might result from autopilot, flight director or autothrottle malfunction should be considered.

4) If a go-around could result in an inadvertent touchdown, the safety of such an event should be considered. The aircraft design and/or procedures used should accommodate relevant factors. Examples of relevant factors to consider include operation and acceleration characteristics of engines, failure of an engine, the operation of autothrottle, autobrakes, autospoilers, autopilot/flight director mode switching, and other systems (e.g., ground sensing logic) which could be adversely affected by an inadvertent touchdown.

5) If the occurrence of any failure condition in the aircraft or its associated equipment could preclude a safe go-around from low altitude, then such failure conditions should be identified. In such a case, a minimum height may be specified from which a safe go-around was demonstrated if the failure occurs. If the failure occurs below the specified height, pilots should be made aware of appropriate procedures to be used, and the effects or consequences of any attempt to go-around.

If necessary, information should be provided to the flightcrew concerning appropriate procedures for low altitude go-around. If the ability to conduct approach and landing operations with an engine inoperative using low minima are intended (e.g., minima below an MDA(H) or DA(H) of approximately 250' HAT), or if procedures if an engine fails during a low altitude go-around require special consideration or are significantly different than for any other go-around, then flight crew procedures to safely conduct such an engine-out go-around should be addressed. If necessary, suitable information to safely conduct such a low altitude go-around should be provided to the flightcrew (e.g., flap configurations and flap retraction procedures, appropriate acceleration to a suitable go-around speed, appropriate use of auto-feather capability).

**5.15. Excessive Deviation Alerting.** Some method is recommended for being able to detect excessive deviation of the aircraft laterally and vertically during approach, and laterally during rollout, as applicable. The method used should not require excessive workload or undue attention. This provision does not require a specified deviation warning method or annunciation, but may be addressed by parameters displayed on the ADI, EADI, or PFD. When a dedicated deviation warning is provided its use must not cause excessive nuisance alerts.

**5.16. Rollout Deceleration Systems or Procedures for Category I or II.**

**5.16.1. Stopping Means.** A means to determine that an aircraft can be reliably stopped within the available length of the runway, considering ambient conditions, is recommended for any operation.

**5.16.2. Antiskid Systems.** Unless otherwise specified by FAA, aircraft authorized for Category I or Category II do not have specific antiskid system installation or use requirements beyond those specified in the applicable AFM, applicable FAA MMEL and MEL, and applicable field length operating rules.

**5.17. Engine Inoperative Category II Capability.** The following criteria are applicable to aircraft systems intended to qualify for "engine inoperative Category II" authorizations. Aircraft demonstrated to meet provisions of Appendix 2 with an "engine inoperative" and that have an appropriate reference to engine inoperative Category II capability in the FAA approved AFM are typically considered to meet the provisions listed below. Other aircraft which have an AFM showing only all-engine Category II capability may additionally be operationally demonstrated for engine inoperative Category II capability in accordance with sections 5.19.1 through 5.19.3 and section 10.5.

1. The AFM or equivalent reference (e.g., operators manual) must suitably describe demonstrated approach and missed approach performance for the engine inoperative configuration, and the aircraft must meet pertinent criteria otherwise required for all-engine Category II or equivalent criteria. Suitable performance information should also be available to the pilot and, if applicable, the aircraft dispatcher to assure safe landing capability in the anticipated configuration and with anticipated speeds, and to establish safe go-around capability from DA(H) and, if applicable, for a balked landing from the TDZ (e.g., equivalent to an obstacle clearance "T-Procedure" for takeoff).

Exceptions to all-engine Category II, or equivalent criteria, may be authorized for engine inoperative Category II as follows:

a. The effects of a second engine failure when conducting Category II operations with an engine inoperative need not be considered,

b. Crew intervention to re-trim the aircraft to address thrust asymmetry following engine loss may be permitted,

c. Alternate electrical and hydraulic system redundancy provisions may be acceptable, as suited to the type design (e.g., bus isolation and electrical generator remaining capability must be suitable for the engine out configuration),

d. Requirements to show acceptable approach performance may be limited to demonstration of acceptable performance during engine out flight demonstrations (e.g., a safe approach to minima), and

e. Approach or Landing system "status" should accurately reflect the aircraft configuration and capability.

2. Suitable information about flight guidance system capability must be available to the flightcrew in flight, particularly at the time of a "continuation to destination" or "diversion to alternate" decision. This is to determine that the aircraft can have an appropriate Category II approach capability when the approach is initiated (e.g., Non-normal checklist specification of expected configuration during approach, autopilot or flight director status annunciation of expected mode capability).

3. The operator should consider system performance in appropriate weather conditions (e.g., winds, turbulence or wind gradients) to make a determination as to whether any weather related restrictions or limitations are appropriate.

**5.18. Special Airports with Irregular Pre-Threshold Terrain.** Not withstanding the fact that most aircraft systems that have completed airworthiness demonstrations consider irregular terrain in the pre-threshold area, special operational evaluations are nonetheless appropriate for certain airports having difficult pre-threshold terrain conditions. These special evaluations consider each particular aircraft type, the particular flight control system, and may include consideration of particular system elements such as the type of radar altimeters installed or other equipment. The need for such a special evaluation is the part 97 approach procedure of FAA order 8400.8 as amended. Criteria for the evaluation of irregular Pre-threshold terrain airports is contained in FAA AC 120-28D Appendix 8.

**5.19. Airborne System Evaluation and Approval.** Category I and Category II airborne systems may be evaluated in accordance with the applicable airworthiness criteria contained in Appendix 2 or 3 during type certification approval or they may be evaluated in conjunction with a FAA-approved program with an air carrier. To be acceptable for Category I or II landing minima, the airborne equipment should meet the criteria in Appendix 2 or 3 of this AC and be able to conduct Category I or II operations in accordance with the operational concepts discussed in Section 4 above. However, if a determination of compliance with Appendix 2 or 3 has not been made, airborne equipment which is demonstrated to meet the operational demonstration criteria in the applicable subparagraphs below may also be acceptable for Category I (e.g., RNP Operations) or Category II landing minima if it is demonstrated that this equipment permits safe Category I or II operations, as applicable, in accordance with the operational concepts discussed in Section 4 above.

**5.19.1. "Operator Use Suitability" Demonstrations - Applicability.**

The following criteria in sections 5.19.2 through 5.19.3 (also see section 10.5) apply to applicants desiring airborne equipment approval for those systems which do not have a statement in the approved airplane flight manual which indicates that the equipment meets the relevant performance standards of this AC, previous editions of this AC, or equivalent criteria (e.g., either for Category I such as applicable to FTE demonstrations for RNP, or for Category II). The criteria of sections 5.19.2 and 5.19.3 are not intended to apply to those aircraft types or variants which already include a statement in the approved airplane flight manual indicating that the airborne flight guidance system was evaluated in accordance with criteria of this Advisory Circular (i.e., AC120-29A).

**5.19.2 Airborne Equipment Operational Validation**. The applicant should provide an acceptable test and evaluation plan which establishes satisfactory performance of the flight guidance system for either the Category I or Category II operations intended, as applicable. To be acceptable, the applicant should conduct an appropriate number of approaches and missed approaches, or other applicable operations, for representative instrument procedures to be flown. For such assessments under this provision, an applicant may be considered to be an operator, a group of operators, or an aircraft manufacturer or avionics manufacturer in conjunction with one or more operators. An aircraft manufacturer or avionics manufacturer seeking to demonstrate alternate levels of FTE without involvement of an operator would normally be expected to do so as part of a TC or STC process, in accordance with criteria of an Appendix of this Advisory Circular.

**5.19.2.1 Category II Assessments.** For Category II, the applicant should typically be expected to perform at least 300 successful approaches to appropriate Category II DA(H) minima, in each aircraft type intended, The 300 approaches may be . allocated to several variants within a type if the flight guidance systems used by each variant are the same or similar. If a related or similar aircraft type is configured with the same or a similar flight guidance system and is already approved for Category II, or for special case consideration such as consideration of an engine inoperative Category II approach, the number of approaches for a particular type or variant may be reduced by an appropriate amount depending on the degree of system similarity, flight guidance performance similarity, or aircraft similarity, as determined appropriate by the CMO, AEG, or AFS-400. Approaches may be accomplished in line operations, during training flights, or during specific demonstration flights, or in any combination. Not less than ninety percent of the total demonstrated approaches conducted should be successful. No unsafe approaches or missed approaches should occur. (See 5.19.3.3 for a definition of a successful approach). Approaches should be accomplished in accordance with the following criteria:

(1) A minimum of three facilities/runways should be used during the demonstrations, unless Category II operations will be conducted only at fewer than 3 facilities by that operator. At least 10 percent of the total number of approaches should be conducted on each of at least three of the facilities selected. The number of approaches conducted on additional facilities may be at the applicant's discretion.

(2) At least some approaches should be accomplished using facilities approved for Category II or Category III Procedures. However, at the applicant's option, demonstration may be made using facilities used only for Category I Procedures.

(3) No more than 15 approaches per day should be conducted on a single facility.

(4) No more than 60 percent of the approaches should be conducted in any single aircraft, unless the operator has 3 or fewer aircraft to be evaluated, and performance of the other aircraft may be considered to be equivalent.

(5) Where an applicant has different variants of a type aircraft which utilize the same or similar flight guidance system, the applicant should assure that each of the variants can meet the necessary performance criteria.

(6) If flight director performance is to be assessed, a representative number of pilots should be used to conduct the necessary approaches. No single pilot should perform more than 20 percent of the approaches, unless a small total number of pilots assigned to the aircraft type requires the use of a greater percentage.

(7) An acceptable sample of the approaches conducted should be observed by an FAA Aviation Safety Inspector or other suitably qualified evaluator(s) (e.g., a check airman representatives of the operator, an APD or equivalent, or representatives from the aircraft or avionics manufacturer), as determined acceptable by FAA .

**5.19.2.2. Flight Technical Error (FTE) Assessments.** Flight Technical Error (FTE) assessments for approach or missed approach, or other defined operations, may be made by an aircraft manufacturer, an avionics manufacturer, or an operator to establish alternate levels of expected FTE to be used for navigation system or procedure authorization. Alternate levels of FTE may then be applied to instrument procedure development or authorization, in lieu of standard assumed FTE values, when the assumptions or conditions of the alternate FTE levels can be met or satisfied.

FTE levels may be established by analysis (e.g., of existing data), by simulation (e.g., in a suitable flight training simulator), through flight verification (e.g., data collected from flight demonstration(s) with an appropriately configured aircraft), or in any combination of these methods. Regardless of the method(s) used, sufficient assessment should take place to assure that any resulting FTE information or values are valid for the navigation conditions or procedures to which they are to be applied. The assessment should key to types of procedures to be flown, appropriately consider normal, non-normal and rare normal operations, should address pilot capability or system variability to the extent necessary, and should have sufficient repeatability to have confidence in the FTE level(s) that result.

Any FTE assessment related exceptions to industry criteria found in sources such as RTCA DO-236 for RNP should be clearly identified, if necessary (e.g., navigation systems for which 22nm constant radius turns are not intended to be applicable).

**5.19.3. Data Collection and Analysis for an Airborne System Evaluation.**

**5.19.3.1. FTE Data Collection and Analysis.** For an FTE assessment demonstration, sufficient data should be collected to establish the suitability of the levels of FTE sought. The data collection and consequent analysis should match and at least consider the types of procedures to be flown (e.g., representative leg types and leg geometry), aircraft configurations to be used (e.g., map display, flight director, autopilot), representative environmental conditions, pertinent normal or non-normal conditions, and representative pilot qualification and experience. Data collection may be from a dedicated FTE assessment, or from data collected during line operations, if appropriate conditions are experienced (e.g., weather) and assumptions satisfied (e.g., pilot sample variability). FTE data collection and analysis may separately address flight on stabilized portions of straight segments, and flight during curved segments or during leg to leg captures. Use of statistical methods for analysis of data is acceptable, but is not necessarily required (e.g. for treatment of certain rare normal or non-normal conditions). The analysis methods or techniques to be used by the applicant and any demonstration program to be used should be determined to be acceptable to FAA prior to commencement of the FTE assessment program.

**5.19.3.2. Data Collection for a Category II Demonstration.** For a Category II system suitability demonstration, each applicant or designated representative should provide the information listed below, as necessary and as requested by the CHDO. This information should be related to performance of the airborne flight guidance system and display system regardless of whether an attempted approach demonstration is successful, unsuccessful, or discontinued. The information, along with recommendations and any clarifying information regarding unsuccessful or discontinued approaches should be provided to the FAA certificate-holding office:

(1) Specify the total number approaches attempted, the number successful, and the number of and reasons for unsuccessful or discontinued approaches, if known,

(2) If an approach is discontinued, specify the height above the runway at which the approach was discontinued.

(3) Specify the acceptability of lateral position, vertical position, track, vertical path/vertical speed, speed error, and pitch trim acceptability at 200' HAT, 100' HAT or at DA(H), and note if the approach was in any way inconsistent with continuing an approach to a normal landing within the touchdown zone,

(4) Specify the navaids and runway facilities used,and the reported weather and wind conditions in which the assessment was conducted,

(5) Evaluate the tracking performance stability, and suitability of the flight director or autopilot, as applicable, for the intended operation.

(6) If not otherwise based on data recording, the evaluator(s) should note and record the lateral and vertical position of the airplane relative to the localizer and glide slope at least at the 200' HAT, 100' HAT or at DA(H), and the estimated runway touchdown point achieved consistent with following the flight guidance system, as applicable to the system used.

(7) If unable to initiate an approach due to a deficiency in the airborne equipment, note the reason for the deficiency and any recommendation for addressing the deficiency.

(8) Provide any other relevant associated recommendations or circumstances.

NOTE: Unsuccessful approaches attributed solely to Air Traffic Service (ATS) circumstances may be excluded from the data (e.g., flights vectored too close to a final fix or at large angles preventing adequate localizer and glide slope capture; termination of an approach at the request of an Air Traffic Facility or due to an amended air traffic clearance; evidence of inappropriate ILS critical area protection). Also, unsuccessful approaches may be excluded from consideration due to faulty navaid or non-aircraft sensor signals. Airborne system failures attributed to maintenance failures or maintenance factors should be documented for subsequent joint resolution by FAA and the operator.

**5.19.3.3. Definition of a Successful Approach for a Category II Demonstration.** For the purpose for the airborne system suitability demonstration for Category II, a successful approach is one in which, at least at the 100' HAT point or DA(H), through touchdown, meets the following criteria:

(1) The airplane is continuously in a position to complete a normal landing using normal maneuvering. Typically this is considered to require that below 200' HAT the flight deck is positioned within and is tracking to remain within, the lateral confines of the extended runway.

(2) The deviation from glide slope does not exceed $\pm$ 75 microamps (1/2 scale) as displayed on the ILS, MLS, GLS, or equivalent system/indicator at least down to the DA(H). Below the DA(H) a normal approach path is followed and a normal flare occurs, with a landing safely within the touchdown zone at normal sink rates and attitudes.

(3) The indicated airspeed, track, vertical speed, alignment and heading are satisfactory. Indicated air speed does not exceed $\pm$ 5 knots of planned approach airspeed but may not be less than computed threshold or reference speed.

(4) No unusual maneuvers or excessive attitude changes or attitude rates occur.

(5) The airplane is generally in trim so as to preclude any excessive control forces.

**5.20. GPWS or EGPWS Interface.**
Airborne equipment used for approach should have appropriate interfaces with or compatibility with GPWS and EGPWS. This is to assure nuisance free operation at routine airports. Special procedures may be used for non-normal procedures or at airports with unusually difficult underlying terrain, or other such factors.

**5.21. Flight Data Recorder (FDR) Interface.**

Airborne equipment used for approach should have appropriate interfaces with or compatibility with flight data recorders, and if applicable cockpit voice recorders (e.g., alerting audio audibility on CVR).

**5.22. Takeoff, or Dispatch, with Inoperative Navigation Receivers, Instruments, or Displays for Category I or II.** Notwithstanding the airborne equipment installation provisions of Sections 5.2 and 5.3 above, and in accordance with any other FAA applicable MMEL and MEL provisions (e.g., as specified by the FAA FOEB or FSB for the type), a pilot may depart or an operator may dispatch an aircraft for Category I or Category II using the following guidelines [e.g., The operator may address MEL provisions stating "As required by the FAR", or equivalent provisions, as shown below].

**5.22.1 Inoperative System Departure or Dispatch For Category I.**

For departure, or dispatch for Category I, if applicable, two navigation receivers are typically required, with each suitable for the route of flight and expected approaches to be conducted (e.g. dual ILS, if flying a route based on expected use of ILS for landing).

If the flight is based on use of a planned approach procedure that specifically requires dual navigation capability (e.g., /E required, or dual NDB required, or dual VOR required) then two pertinent systems are required for takeoff or dispatch.

If an approach procedure planned for use is not precluded from being conducted using one navigation source (e.g., one NDB, one FMS, one ILS) a minimum of one navigation receiver, or equivalent, of each type required for the intended flight is required. That navigation receiver's indication, or equivalent, should be able to be displayed at or be visible to each required pilot station, for each type of facility(s) intended for landing. Use of this provision requires considering subsequent failure of the one system intended for use (e.g., the ILS) and the need to be able to safely use any alternate remaining navigation system(s) (e.g., VOR or RNAV) while enroute, during approach, or during missed approach. In any instance, after the first failure in flight, there must still be another suitable navigation capability available to the aircraft to safely land. The other navigation capability required above may be based on use of a different NAVAID type, use of acceptable RNAV capability, or use of an alternate airport with the same or a different type of instrument procedure.

Instruments, or displays, or display elements may be inoperative if, considering the remaining instruments or displays, each pilot can accomplish that pilot's respective assigned crew duties for flying and monitoring the flight (e.g., failure of an ILS raw data display on the F/O's ADI or PFD may be permissible if that information or equivalent is available by other acceptable means - such as by using the F/O's HSI LOC or ND LOC indication in lieu of the ADI LOC indication). When considering inoperative component(s), subsequent failure of any single additional instrument, or display, or display component must not put the aircraft or crew in an unsafe situation for which the pilots cannot safely compensate (e.g., it is determined to be acceptable in the above example that after a subsequent failure the F/O will be able to acceptably monitor the Capt's corresponding instruments, or standby instruments).

**5.22.2 Inoperative System Departure or Dispatch For Category II.**

For departure, or dispatch, for Category II, a minimum of two LOC or GLS navigation receivers of each type to be used are normally required for Category II. The receiver's indications to be used should be able to be independently displayed at or be visible to each respective pilot station, for each type of facility(s) intended for landing (e.g., ILS, MLS or GLS). For ILS glide slope, only one receiver need be operative for departure or dispatch, if that receiver is a self monitored receiver with reliable failure indication, if the receiver information can be displayed at each pilots station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

Use of the "departure or dispatch with a single glideslope receiver" provision requires considering subsequent failure of the one GS system intended for use while enroute or on approach, and the need to be able to safely use alternate remaining navigation system(s) to safely land, after failure of the glideslope receiver in flight.

Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station , or be easily visible to each pilot station.

NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the operator is not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for takeoff or dispatch for purposes of establishing landing minima (e.g., for DA(H)). This provision does not address other MMEL/MEL provisions that may otherwise independently apply to radar altimeter availability, however, such as for appropriate GPWS function.

In addition to instruments and displays for Category II, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti ice for icing conditions, windshield wipers or equivalent for rain).

**5.22.3 Inoperative System Departure or Dispatch For Either Category I or Category II.**

For departure or dispatch for either Category I or II, for EFIS aircraft that have capability to switch entire display formats to different flight deck display locations, these systems typically may be dispatched with an inoperative display, or with displays in alternate locations. For an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the aircraft must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

Operators should assure that planned operations consider any pertinent AFM or FCOM provisions for flight guidance system use that may relate to inoperative components (e.g, altimeter source, nav source, or instrument source switching, and available flight director or autopilot modes, as applicable).

**5.23. Continuation of Flight After Navigation System Failure Enroute, or During Approach, for Category I or II.**

Notwithstanding the airborne equipment installation provisions of Sections 5.2 and 5.3 above, MMEL and MEL provisions of Section 5.22 above, and any other FAA applicable FSB provisions for the type aircraft, a pilot may continue enroute or initiate an approach to Category I or Category II minima using the following guidelines of 5.23.1 through 5.23.3.

**5.23.1 Continuation of a Flight After Failures For Category I.**
The operator should establish a policy addressing typical failure conditions for which initiation or continuation of an approach in low visibility conditions is considered acceptable (e.g., failure of a single flight director, FCC, or instrument, for which switching to a an alternate or common source still provides adequate information). Operators should also describe typical conditions for which the operator would expect that a pilot would divert to a different airport with better weather conditions, if possible (e.g., for complex engine or hydraulic failures where flight guidance or go-around performance may be significantly degraded).

Unless dual capability is specifically required for a particular procedure (e.g., /E required, dual NDB required), for initiation or continuation of approach, a minimum of at least one navigation receiver or sensor of each type required for the intended approach procedure is required. If an approach is initiated with only one receiver or sensor, the pilot should, to the extent possible, consider the potential consequence of subsequent failure of that system or sensor.

**5.23.2 Continuation of a Flight After Failures For Category II.**
For continuation enroute or initiation of an approach, a minimum of one LOC or GLS navigation receiver of each type to be used is normally required for initiation or continuation of Category II approach. The receiver's displacement indications, if applicable, should, however, be able to be independently displayed at or be visible to each respective pilot station, for each type of facility(s) intended for landing (e.g., ILS, MLS or GLS). For ILS glide slope, only one receiver need be operative for approach if the receiver information can be displayed at each pilots station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station , or be easily visible to each pilot station.

NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the aircraft and crew are not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for approach, for purposes of establishing landing minima (e.g., for DA(H)).

In addition to suitable instruments and displays, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti ice for icing conditions, windshield wipers or equivalent for rain).

**5.23.3 Continuation of a Flight After Failures For either Category I or Category II.**
If a flight is to be continued to destination and the originally planned instrument approach procedure(s) used after a failure enroute, or if an approach is to be continued, the pilot should consider the consequence to and alternatives available for the flight if remaining navigation receiver or sensor capability should subsequently fail.

For EFIS aircraft that have capability to switch entire display formats to different flight deck display locations following a failure, these systems typically may be switched to an operative display, or display in an alternate location. For a failed display or an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the aircraft must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

Pilots should assure that planned operations consider any pertinent AFM or FCOM provisions for flight guidance system use that may relate to inoperative components (e.g, altimeter source, nav source, or instrument source switching, and available flight director or autopilot modes, as applicable).

A pilot exercising emergency authority may deviate from the above or any other provisions of this AC to the extent necessary to assure safe flight and landing.

**6. PROCEDURES.**

**6.1. Operational Procedures.** Appropriate operational procedures based on the approved operator program should be addressed. Operational procedures should consider the pilot qualification and training program, airplane flight manual, crew coordination, monitoring, appropriate takeoff and landing minima including specification of either a DA(H) or MDA(H), as applicable, for landing, crew call-outs, and assurance of appropriate aircraft configurations. Suitable operational procedures must be implemented by the operator and be used by flightcrews prior to conducting low visibility Category I or II landing operations.

**6.1.1. AFM Provisions.** The operator's procedures for low visibility takeoff or Category I or II landing should be consistent with AFM provisions specified during airworthiness demonstrations. Adjustments of AFM procedures consistent with operator requirements are permitted when approved by the POI. Operators should assure that no adjustments to procedures are made which invalidate the applicability of the original airworthiness demonstration.

**6.1.2. Crew Coordination.** Appropriate procedures for crew coordination should be established so that each flight crewmember can carry out their assigned responsibilities. Briefings prior to the applicable takeoff or approach should be specified to assure appropriate and necessary crew communications. Responsibilities and assignment of tasks should be clearly understood by crewmembers. Tasks should be accomplished consistent with the operator's specified provisions for the aircraft type or variant and each crewmember position unless otherwise approved by the POI (duties of each pilot, monitored approach, etc.).

**6.1.3. Monitoring.** Operators should establish appropriate monitoring procedures for each type of low visibility approach, landing, and missed approach. Procedures should assure that adequate crew attention can be devoted to control of aircraft flight path, displacements from intended path, mode annunciations, failure annunciations and warnings, and adherence to minima requirements associated with DA(H) or MDA(H).

In the event that a "monitored approach" is used, (e.g., where the first officer is responsible for control of the aircraft flight path by monitoring of the automatic flight system) appropriate procedures should be established for transfer of control to the pilot who will be making the decision for continuation of the landing at or prior to DA(H) or MDA(H).

Monitoring procedures should not require a transfer of responsibility or transfer of control at a time that could interfere with safe landing of the aircraft. Procedures for calling out failure conditions should be pre-established, and responsibility for alerting other crewmembers to a failure condition should be clearly identified.

**6.1.4. Use of the DA(H) and MDA(H).** Decision Altitude (Height) is used for Category I and II operations. Decision Altitude (Height) is used when vertical path guidance is available (e.g., ILS, GLS, MLS, VNAV). Decision Altitude (DA) is used for barometrically determined altitude minima (MSL), typically associated with Category I procedures where vertical guidance is available. If specifically authorized by FAA (rare uses) a DA may in some circumstances be used for Category II.

Decision Height (DH) is used for Category II operations, except where use of an Inner Marker is authorized in lieu of a DH, or where a DA is authorized (rare use).

When DAs or DHs are specified, procedures for setting various reference bugs in the cockpit should be clearly identified, responsibilities for DA or DH call-outs should be clearly defined, and visual reference requirements necessary at DA or DH should be clearly specified, so that flightcrews are aware of the necessary visual references that must be established by, and maintained after passing DA or DH.

MDA(H) is typically used for procedures that do not have vertical path guidance (e.g., VOR, NDB, 2D-RNAV, Circling). U.S. Operators are authorized to use MDA. MDH may be used internationally by non-US operators, and U.S. operators may need to be aware of its existence and use when operating to international locations even though U.S. operators are not typically authorized to use MDH. Any request for use of MDH must be coordinated with AFS-400. Also the "height element (H)", used with MDA(H), provides an advisory value for RA relative to the airport or TDZ elevation, and may be used for situation awareness, even if not used to actually define minima. Caution should be noted however, since irregular terrain in the

vicinity of the airport may result in observed RA values that are significantly different than expected height (H) derived from the published procedure when not over or near the airport surface.

Procedures should be specified for call-out of the DA, DH, or MDA(H).

Procedures should be specified for conversion of the DA or DH to an MDA(H) in the event that the aircraft reverts from or loses vertical path guidance. However, any adjustments to approach minima or procedures made on final approach should be completed at a safe altitude (e.g., above 1000 feet HAT).

Any use of QFE procedures for DA or DH for operators that are not already so authorized (applicable to either Category I or II, whether inside the U.S. or outside the U.S.) must be specifically approved by the CHDO, after coordination with AFS-400.

For Category II, the operator should assure that at each runway intended for Category II operations, the radar altimeter systems used to define Decision Height provides consistent, reliable, and appropriate readings for determination of Decision Height. In the event of irregular terrain underlying the approach path an alternate method should be used. DH may be based on other means (e.g., inner marker) when specifically approved by FAA.

**6.1.5. Callouts.** Altitude/Height callouts should be developed, implemented, and used for Category I and Category II operations. When more than one Category of operation is used (e.g., Category I or II) callouts should be compatible, consistent, and preferably common to as many Categories of Operation as practicable.

Callouts may be accomplished by the flightcrew or may be automatic (e.g., using synthetic voice call-outs or a tone system). Typical call-outs acceptable for Category I or Category II include the following:

- "1000 feet" above the touchdown zone,
- "500 feet" above the touchdown zone,
- "approaching minimums,"
- "at minimums," as applicable,
- [any pertinent visual reference(s) observed, and resulting crew action], as applicable (e.g., "runway in sight,... landing"),
- key altitudes during flare, (e.g., 50, 30, 10) or AFGS mode transitions (e.g., flare, rollout), and
- as appropriate, auto spoiler, reverse thrust deployment and autobrake disconnect.

Combinations of these calls may also be used as appropriate. In any event, the calls made by the flightcrew should not conflict with the automatic systems or auto call-outs of the aircraft, and conversely the configuration selected for the aircraft should not conflict with expected call-outs to be made by the flightcrew. Compatibility between the automatic call-outs and the crew call-outs must be assured. The number of call-outs made, either automatically, manually or in combination, should not be so frequent as to interfere with necessary crew communication for abnormal events.

Also, call-outs should be specified to address any non-normal configurations, mode switches, failed modes, or other failures that could affect safe flight, continuation of the landing, or the accomplishment of a safe missed approach. Any use of crew initiated call-outs at altitudes below 100 feet during flare should assure that the callouts do not require undue concentration of the non-flying pilot on reading of the radar altimeter rather than monitoring the overall configuration of the aircraft, mode switching, and annunciations. Automatic altitude call-outs or tones are recommended for altitude awareness, at least at and after passing DA(H) or Minimum Descent Altitude (Height).

**6.1.6. Configurations.** Operational procedures should accommodate any authorized aircraft configurations that might be required for Category I or Category II approaches or missed approaches. Examples of configurations that operational procedures that an operator may need to accommodate include:

1. Alternate flap settings,

2. Use of alternate AFGS modes or configurations (e.g., with or without autopilot(s) or flight director(s), autoland, HUD),

3. Inoperative equipment provisions related to engine(s) inoperative, or the minimum equipment list, such as a non-availability of certain, inoperative instruments (e.g., PFD, radar altimeter), air data computers, hydraulic systems or instrument switching system components, and

4. Availability and use of various electrical system components (e.g., generator(s) inoperative), alternate electrical power sources (e.g., APU) if required as a standby source.

5. If applicable, describing the relationship of approach minima to any decision or commit points for critical aircraft configurations that are identified by the operator (e.g., two engines inoperative procedures for three or four engine aircraft, or abnormal flight control configuration procedures)

Procedures required to accommodate various aircraft configurations should be readily available to the flightcrew to preclude the inadvertent use of an incorrect procedure or configuration. Acceptable configurations for that operator and aircraft type should be clearly identified so that the crews can easily determine whether the aircraft is or is not in a configuration to initiate a low visibility approach using a pertinent Category I or Category II procedure.

Configuration provisions must be consistent with, but are not limited to, those provided in the OpSpecs for that operator.

**6.1.7. Compatibility between Category I, Category II and Category III Procedures.** The operator should ensure that to the extent possible, flightcrew and operational procedures for Category I and Category II are consistent with the procedures for that operator for Category III, particularly to minimize confusion about which procedure should be used in variable weather.

The operator should to the extent practical, minimize the number of procedures that the crew needs to be familiar with for low visibility operations so that, regardless of the landing category necessary for an approach, the correct procedures can be used consistently and reliably.

**6.1.8. Procedure Considerations During Non-Normal Operations.** When procedures or configurations have been specified for non-normal situations, flightcrews are expected to apply those procedures and use good judgment in making the determination of any appropriate adjustments to safely use an instrument approach procedure. This may include identifying any necessary adjustments to DA(H), MDA(H), approach path, missed approach path, or required visibility believed to be necessary (e.g., assessing the climb gradient that can be achieved, identifying a safe engine out lateral and vertical flight path, requesting an appropriate length of final approach). Guidelines for non-normal configurations, situations, or procedures may be provided by the aircraft flight manual or by the operator. Crews are expected to be familiar with these guidelines and apply them to the extent practical.

Specific guidelines for initiation for a Category II approach with an inoperative engine are provided in section 5.17.

When procedures or configurations have not been specified for a non-normal situation or configuration, flightcrews are expected to use good judgment and select the safest course of action in making the determination of appropriate configurations or margins for an approach. The decisions to initiate, continue, or to discontinue an approach, divert to an alternate, and any adjustments to minima should be made considering relevant factors such as:

- Seriousness of the emergency,

- Failure status of the aircraft,

- Potential for unknown damage or further failures,

- Navigation system status,

- Runway, visual aid, and NAVAID status,

- Procedure flight path and minima to be used

- Proximity to high terrain, obstacles, or adjacent approaching aircraft

- Potential altitude loss, flight path required, or cleanup altitude needed to change configuration and accelerate for a missed approach,

- Obstacle clearance during transition to a missed approach (including the possible need to reject the landing from below DA(H) or MDA(H),

- Fuel on board,

- Distance and suitability of alternate airports, and

- Likelihood of changing weather, NAVAID, or runway conditions,

It is not the intent of this circular to comprehensively define guidelines for each circumstance that might be possible (e.g., serious in-flight fire, minimum fuel). It should be noted, however, that flightcrew have both the authority and responsibility to consider relevant factors, such as those identified above, when deciding the safest course of action. If doubt exists on a course of action (e.g., initiating or continuing an approach with conditions potentially below minima), it is the flightcrews responsibility to exercise any necessary emergency authority to assure safe flight.

**6.2. Category I or Category II Instrument Approach Procedures.**

**6.2.1. Acceptable Procedures for Category I.** Procedures acceptable for a Category I authorization for a U.S. Operator in the U.S., or internationally, under provisions of part 121, 125 or 135, or for a Foreign Operator under provisions of Part 129 at U.S. Airports, are those listed in Sections 4.3.1.4, 4.3.2, and 4.3.3 above, and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

**6.2.2. Acceptable Procedures for Category II.** Procedures acceptable for a Category II authorization for a U.S. Operator in the U.S., or internationally, under provisions of part 121,125 or 135, or for a Foreign Operator under provisions of Part 129 at U.S. Airports, are those listed in Sections 4.3.1.4 and 4.3.2 above, and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

**6.2.3. Standard Obstacle clearance for approach and missed approach.** Standard approach and missed approach criteria for obstacle clearance for normal operations are as specified in the U.S. Standard for Terminal Instrument Procedures FAA Order 8260.3, as amended, or as referenced in FAA Air Traffic criteria for terminal procedures (e.g., FAA Order 7100.11), or for non-U.S. airports, ICAO PANS-OPS.

Standard VNAV criteria may be applied as specified in FAA order 8260.40, as amended.

Standard RNP criteria may be applied as specified in Appendix 5 of this AC or pertinent sections of AC120-28D.

For non-normal operations (e.g., engine inoperative), criteria equivalent to that specified in Federal Aviation Regulations for takeoff (e.g., section 121.189) may be applied for those portions of an approach or missed approach not otherwise addressed by procedure design for normal operations (e.g., engine out missed approach gradients, or engine inoperative flap retraction

and acceleration segments, or a rejected landing climb back to procedurally protected airspace after loss of visual reference at an airport with significant nearby obstacles or mountainous terrain)

Regardless of criteria used, the operator should assure appropriate consistency between obstacle clearance criteria used for takeoff, en route operations, terminal procedures, instrument approach procedures, engine inoperative procedures, and driftdown procedures, as applicable.

**6.2.4 Special Obstacle criteria**

Obstacle criteria for RNP is as identified in Appendix 5 .

Obstacle clearance criteria for Category II procedures is identified in Appendix 6.

Obstacle clearance criteria to facilitate implementation of VNAV paths for approaches other than xLS are contained in FAA Order 8400.10 Handbook Bulletin-Air transportation (HBAT) 99-xx.

Other obstacle clearance criteria may be requested for use by an applicant and authorized by FAA, for specific applications (e.g., international operations, operations at military facilities, disaster relief). When other criteria is used, related compensating factors are typically considered, to assure equivalent safe terrain or obstacle clearance.

**6.2.5. Irregular Terrain Airports.** Pre-threshold runway irregular terrain airports identified by an part 97 procedure, or by FAA Order 8400.8, as amended, must be evaluated in accordance with FAA approved procedures prior to incorporation in OpSpecs for use by air carriers operating to Category II minima.

> (See the FAA worldwide web site for Category II/II Status Checklist Bulletin Board, for Restricted or Irregular Terrain airports: http://www.faa.gov/avr/afs/afs410/afs410.htm).

Acceptable procedures for evaluation of use of these airports may be found in of AC 120-28D, Appendix 8. For aircraft not using autoland, this evaluation consists primarily of assuring availability of an appropriate method for identification of DA(H) (e.g., assessing acceptable radar altimeter indications approaching and at DA(H), or substituting use of "Inner Marker" in lieu of Radio Altimeter). Assessing acceptable radar altimeter indications is done by assuring sufficient Radio Altimeter display readout stability and continuity to be able to be easily read the Radar Altimeter when approaching DA(H) and at DA(H), while overflying the irregular underlying terrain. This assessment may typically be done during operations using minima no lower than Category I, or may be based on operations at that runway by that operator with an equivalent radio altimeter installation (e.g., previously in a B757, for new B767 operations), or may be based on other U.S. Operators who have completed an assessment using the same aircraft type and radio altimeter system combination, or equivalent.

**6.2.6. Airport Surface Depiction for Category I or II Operations.** Unless otherwise authorized for a particular airport or series of airports, a suitable airport surface depiction should be available to flightcrews for each regular, provisional, alternate airport or any airport the operator could reasonably expect operations (e.g., section 121.161 ETOPS diversion airports, designated emergency airports), to assure appropriate identification of visual landmarks or lighting to safely accomplish taxing from the gate to the runway and from the runway to the gate. Airport depiction should be on an appropriate scale with suitable detailed information on gate locations, parking locations, holding locations, critical areas, obstacle free zones, taxi way identifications, runway identifications, and any applicable taxiway markings for designated holding spots or holding areas. Standard depictions provided by commercial charting services may be acceptable if they provide sufficient detail to identify suitable routes of taxi to and from the runway and gate positions for departure or arrival.

Electronic presentations of airport diagrams are considered an acceptable substitute for paper (hard copy) depictions if acceptable operational provision is made for failure of the electronic device providing the airport depiction, if each necessary flight crewmember can have access to the depiction when needed, and if equivalent scaling, orientation, chart detail, and information content is provided.

**6.2.7. Continuing Category I or Category II Approaches in Deteriorating Weather Conditions.** The following procedures are considered acceptable in the event that weather conditions are reported to drop below the applicable Category I

or II minima after an aircraft has passed the final approach point or final approach fix, as applicable (reference section 121.651).

1) Operations based on a DA(H) may continue to the DA(H) and then land, if the specified visual reference is subsequently established by the pilot no later than the DA(H).

2) Operations based on an MDA(H) may continue to the MDA(H), and then to the point of intercept of the VNAV path to the runway, to the VDP, or equivalent, or to the MAP, as applicable, then land, if the specified visual reference is established by the pilot no later than point at which descent below the MDA(H) commences.

For wind constraint applicability on final approach see Section 6.2.11.

**6.2.8. "Approach Ban" Applicability.** Sections 121.651, 125.381 and 135.225 generally require that weather conditions be at or above takeoff minima prior to takeoff, and above landing minima prior to initiating the final segment of an instrument approach. However the applicability of these rules can be different for certain Domestic and International Operations (e.g., pilots authority to initiate "Look-See" Approaches at non-U.S. airports when weather is reported below minima). This section explains and clarifies applicability of weather reporting for takeoff minima, and applicability of the "approach ban" provision related to sections 121.651, 125.381 or 135.225 at U.S. and non-U.S. airports.

Accordingly, an instrument approach should not be continued beyond the applicable outer marker, final approach fix, or equivalent position in the final approach segment unless the reported visibility or controlling RVR is above the specified minimum. If no outer marker, final approach fix, or equivalent fix is available, or if such a fix is not used as the point of application of an approach ban when weather is reported below minima, the aircraft should in no case descend below an altitude of 1,000 feet above the TDZE for the runway of intended landing, unless weather is reported to be at or above minima. Equivalent positions to the outer marker are considered to be, but are not limited to: DME, VOR, non-directional beacon, or other such fixes authorized in the standard instrument approach procedure, which are located at a position similar to an outer marker, outer compass locator, or final approach fix. A corresponding surveillance radar fix may also be used as a point of application of an approach ban, in lieu of an outer marker, final approach fix, or such equivalent fix.

If, after passing the applicable approach ban fix or point (e.g., outer marker, equivalent fix, or an altitude 1,000 feet above the TDZ Elevation), and the reported visibility or controlling RVR falls below the specified minimum, the approach may be continued to DA(H) or MDA(H). If suitable visual reference can be established prior to descending below DA(H) or MDA(H), a landing may be completed.

Controlling RVR means the reported values of one or more RVR reporting locations (touchdown, midpoint, rollout, or equivalent international locations) used to determine whether operating minima are or are not met. Where RVR is used, the controlling RVR is the touchdown RVR, unless otherwise specified by FAA (e.g. through operations-specifications).

Differences in application of the approach ban between U.S. airports and non-U.S. airports stems from the recognition that there may be differences in non-U.S. and U.S. methods to determine and report weather conditions. On a worldwide basis, differences exist in types and characteristics of meteorological devices used, measurement techniques and policies, or processes for categorizing, reporting or disseminating weather (e.g., different methods of determining and reporting RVR or meteorological visibility).

An approach ban is applicable at U.S. airports. It may also apply at airports in countries outside the U.S. where that state or airport authority specifically precludes "look-see" authorization when weather is below minima. Operators should be familiar with such policies of states outside the U.S., or for non-US airports, and appropriately apply those states or airports policies.

Federal Aviation Regulations and FAA policies require that for airports within the U.S. and its territories (e.g., Puerto Rico) or at U.S. military airports (e.g., airports at which U.S. military forces manage the facility or have a designated U.S. base or facility) it is necessary to have reported weather at a value at or above landing minima prior to initiating an approach (section 121.651).

The latest weather report from the most reliable source is considered to be the applicable controlling weather report as follows:

1) Report from a co-located Air traffic Facility (e.g., Tower Local Control, Approach control), or
2) ATIS Report, or
3) Airline or FSS report from NWS or an approved source

**6.2.9 Approach Operations at Non-U.S. airports, When Weather is Reported "Below Minima".** This section describes the regulatory basis for executing an instrument approach procedure (IAP) at a non-U.S. airport when it is previously known that the weather at that airport may be, or is below the charted weather minima or approach ban weather criteria for that IAP.

When an aircraft approaches an airport a decision must typically be made whether or not to initiate the approach and whether it is permissible to proceed beyond the FAF or FAP on an IAP, based on specified "approach minima."

These criteria are not necessarily the same as the charted criteria at the bottom of the approach plate, since in ICAO compliant publications, some States set approach minimums for an IAP by specifying an "approach ban" at weather minima different than that specified on the approach plate or OpSpecs for continuing below or beyond DA(H) or MDA(H).

The approach initiation minimums for an IAP may or may not be the same as the landing minimums shown on the IAP.

The following criteria are considered to apply as noted below (reference FAR 91.703 and 121.11).

1. Operations Specifications: Always apply, domestic and international.

2. State of the Aerodrome criteria if promulgated as rules or regulations: Typically always apply in the national airspace of that state, as an agreed sovereign right.

3. FAR Part 121 always applies to domestic operations, and always applies internationally unless the State of the Aerodrome specifically prohibits use of a particular part or provision of the FAR, or promulgates a rule contradicting an FAR, and the FAA agrees to apply the overriding provision of the State of the Aerodrome rather than the FAR. Typically State of the Aerodrome provisions may be more restrictive than the FARs, but may not provide relief from a U.S. regulation that applies to international operation.

   FAR 121.651 Paragraph (b) addresses approach minimums. In subparagraph (b)(1), a weather report for that airport is required prior to commencing an IAP. This is required worldwide.

   In FAR 121 subparagraph (b)(2), it is required that the reported visibility be at least as good as the "visibility minimums prescribed for that approach" prior to commencing an IAP. This visibility requirement only applies, however to airports in the U.S., its territories, and U.S. military airports (whether in the U.S. or outside the U.S.).

   FAR 121 Paragraph (c) allows the crew to continue an IAP to DA(H) or MDA(H) if a below minimums weather report is received while already on the final segment of the approach.

   FAR 121 Paragraph (d) allows an ILS Category I Procedure to be conducted with below minimums weather if both the ILS and a PAR are used simultaneously by the pilot. This does not apply to an operator not authorized for use of PAR, since that operator may not train for PAR approaches.

   Accordingly, there is no FAR Part 121 requirement for an above minimums weather report to commence an IAP in a foreign State (e.g., using a weather source other than the NWS or a source approved by the NWS) unless FAA has specifically precluded use of the look-see provision for a particular State, or States. (Note: The State of the Aerodrome or Airport however may additionally preclude such below minima operations, and U.S. Operators are expected to abide by such provisions, unless otherwise approved by FAA (e.g., through an emergency authorization in time of conflict, natural disaster).

4. ICAO Standards apply over the high seas (international airspace), and in the airspace of a State which adheres to the ICAO Convention, subject to modification by that State, or ICAO filed "Difference".

ICAO Standards and Recommended Practices (e.g., ICAO Annex 2, Annex 6, and PANS-OPS) do not address "approach minimums," or any particular weather criteria applying to the decision whether to initiate or continue an IAP. (Also see "ICAO Manual of All-Weather Operations" DOC 9365 AN/910.)

5. Part 91always applies to domestic operations unless superseded by an FAR Part 121 provision. Internationally certain provisions of FAR 91 apply when not otherwise superseded by part 121, ICAO or State of the Aerodrome rules. Section 91.175 does not specifically address minimums related to initiation of an approach, or any weather criteria for initiating an IAP. All references are to landing minimums and the required visual references to continue below DA(H) or MDA(H). For air carriers conducting operations under FAR 91 (e.g., training, ferry, aircraft functional flight test), the approach ban provisions of FAR 121 may thus not necessarily apply if the particular operation is considered to be conducted under FAR 91 by the CMO. Also, for flight test and POC demonstration purposes, waivers to provisions of FAR 91.175 may be requested from FAA (e.g., such as to authorize limited use of reduced weather minima for test or evaluation purposes).

**6.2.10. IFR Approaches or Low Visibility Takeoffs in Class G Airspace.** An operator may be authorized to conduct IFR approaches to Category I or Category II minima, or low visibility takeoffs, in Class G airspace, if the requirements of the applicable OpSpecs are met.

(1) Nonscheduled Operations. For nonscheduled operations, the CHDO must ensure that the operator's Category I or II operations program provides the policy, and direction and guidance necessary to safely conduct these operations. The CHDO must also ensure that the certificate holder's manuals cover the specific procedures which must be used, and the facilities and services which must be available and operational for the safe conduct of instrument approach operations in Class G airspace (e.g., weather reporting, advisory frequencies, and NAVAID critical area protection, as applicable).

(2) Scheduled Operations. In addition to meeting the requirements for nonscheduled operations, the CHDO must ensure that the facilities and services necessary for the safe conduct of instrument approach procedures in Class G airspace are available during the times of scheduled operations, and are specified in the OpSpecs.

(3) Method of Approval. The authorizations to conduct instrument approach procedures in Class G airspace are addressed by issuing paragraph C064 or H113 of the OpSpecs.

**6.2.11. Wind Constraint Applicability.**

When wind constraints apply to Category I or Category II procedures (e.g., an Operation-Specification 15 knot crosswind component limit) the limit is considered to apply to the point of touchdown. If a report of a crosswind component value greater than the limit is received while on approach, an aircraft may continue an approach, but a subsequent wind report indicating winds are within limits or a pilot determination that actual winds are within limits must be made prior to touchdown. Acceptable methods for such a determination may include ATS reports, reports of other aircraft with reliable means of wind determination (e.g. IRS), pilot use of on board IRS or FMS wind readout capability, data link of recent winds, or pilot confirmation of an acceptable visual indication of winds on the surface by a wind sock, wind indicator or equivalent wind indicating device.

When an Airplane Flight Manual or other manufacturer’s reference (e.g., FCOM) references “Maximum wind component speeds when landing weather minima are predicated on autoland operations”, or an equivalent statement, an operator or flight crew may consider those wind values to apply to “steady state” wind components. Any gust values which exceed the steady state wind limit need not be addressed if the flight crew determines the gust exceedance can be considered insignificant in magnitude, variable in direction, occasional, or otherwise not applicable (e.g., obviously outdated gust report, winds and gusts reported at a location considered far from the runway or touchdown zone and not applicable, or gusts considered not pertinent during the period of touchdown or rollout).

**6.2.12. Crosswind Component Determination at Airports with Significant Magnetic Variation (Polar Regions).** Operators, flightcrews, and dispatchers (if applicable) of air carriers operating in polar regions or having ETOPS or EROPS alternates in these polar regions should be familiar with appropriate methods to determine wind components and particularly

tailwind and crosswind components at airports with significant magnetic variation, or with runways oriented to True North. Due to METAR, TAF, and ATS Tower reported winds and runways potentially having different magnetic or true North reference, caution must be exercised where significant magnetic variation values exist, to correctly determine applicable crosswind and tailwind component limits.

### 6.2.13 Unusual or Extreme Temperatures or Pressures

**6.2.13.1 General Cold Temperature Considerations.** Appropriate "cold temperature" altitude adjustments for instrument procedure minimum segment altitudes (e.g., initial or intermediate segments) should be made when altitude errors resulting from unusually cold airport surface temperatures are considered significant, and are needed to assure terrain or obstacle clearance. Appropriate corrections may be made by instrument procedure designers, airspace planners, Authorities, Air Traffic Service (ATS), operators or pilots, as necessary. Altitude errors typically may be considered significant in mountainous regions when surface temperatures are below -22F/-30C, when significant terrain or obstacle clearance is a factor, and when temperature considerations have not otherwise been addressed by instrument procedure design. Corrections should not additionally be made by flight crews if instrument procedures already address temperature related terrain or obstacle clearance to the degree necessary, or if ATS has addressed cold temperature considerations in their assigned clearance altitudes. Use of any altitude corrections made by flight crews should be consistent with ATS cold temperature altitude correction policies when such policies are promulgated, and when safe clearance is assured by those ATS policies. (Also see sections 4.3.1.1 item 7, 4.3.4. item c., 7.1.3. items 4 and 8 , 8.13, and 8.14 for related information).

**6.2.13.2 Temperatures Below Those Used In Procedure Design.** In some countries, cold temperature errors are considered during procedure design, and are addressed in published instrument procedures, MEAs, and Air Traffic Service (ATS) minimum clearance altitudes such as MVAs when necessary. If temperatures are significantly below the reference temperature considered during procedure design, it may be appropriate for pilots or operators to apply altitude corrections to the specified (published or charted) procedure minimum altitudes while in flight. This may be done using an appropriate altitude correction table as provided in Table 6.2.13-1 below, or through an equivalent table or method, to assure terrain or obstacle clearance.

**6.2.13.3 Segments Which May Need To Be Corrected For Temperature.** Altitude corrections are particularly important on initial or intermediate approach segments in areas of mountainous terrain when there is a significant difference between true altitude and indicated altitude due to unusually cold surface temperatures. This typically occurs for instrument procedure segments more than 3000 ft. above the airport elevation when unusually cold temperatures exist at the landing airport. While it may be appropriate to also adjust DA(H) or MDA(H), such as for a very high landing minima value (e.g., a (DA(H) or MDA(H) above 1000 feet HAT), or adjust high "step-down fix" crossing altitudes inside a final approach fix, errors at these heights above airport are not usually large. Additionally, the size of any temperature induced altitude or height error decreases in magnitude as the height above the airport surface decreases. Corrections may also be appropriate for MEAs, MVAs, "driftdown" flight paths in mountainous terrain, or missed approach or takeoff flight paths, when extreme cold temperature effects are not otherwise considered, and the obstacle clearance altitude or segment height in question is significantly above airport elevation. When a US Air Traffic Facility, or international ATS facility already considers cold temperature effects in clearances, additional corrections by flight crews should not normally be made (e.g., for a radar vector altitude clearance).

**6.2.13.4 Uncorrected Procedures.** In certain states, cold temperature correction may need to be applied any time temperature is below ISA (e.g., Canada, Northern Europe, when using ICAO criteria). When flying to such states, it is important for the operator and pilots to be aware of that state's cold temperature instrument procedure correction policy, and to operate consistent with that policy. This may be accomplished by an operator applying that state's policy, or by the operator using the operator's own policy, if that policy provides for safe clearance and is suitable for use within that state (e.g., the operators altitude correction policy for cold temperature is compatible with that state's ATS procedures or requirements).

**6.2.13.5 VNAV And Visual Guidance (VASI/PAPI) Temperature Considerations.** Pilots and operators should be aware that temperature related effects on VNAV path formulation can occur when operating well below or above ISA. For example, in extreme cold temperatures VNAV descent gradients may be more shallow than usual and visual aids (e.g., VASI/PAPI) may not necessarily show "on path" indications when visual reference is first acquired, even though the aircraft is correctly flying the FMS indicated VNAV path. In such cases, pilots should be alert for the need to adjust and assure a safe flight path. Similarly, pilots and operators should be aware that unusually shallow VNAVgradients could be lower than "step down" crossing altitudes if temperature considerations have not been addressed. For temperatures well above ISA, VNAV descent angles may be correspondingly steeper than nominal. While obstacle clearance would not be an issue, aircraft descent gradient capability could be a factor if operating near descent gradient

limits for the aircraft (e.g., with unusual tailwind conditions at altitude, or with reduced flap settings with an engine inoperative).

**6.2.13.6 Unusual Cold Temperature Operations Within The US.** Within the US, cold temperature factors are typically considered by procedure designers when necessary (e.g., during procedure design) or are considered by airspace planners to the extent necessary (e.g., when establishing MVAs in cold climates and mountainous areas). However, since assessments for cold temperature correction may vary for particular procedures or situations, if an operator has questions as to the suitability of a particular procedure in extreme cold conditions, operators may consult the appropriate FAA procedure design office through their respective POI or CMO to determine what additional precautions or adjustments may be appropriate in extreme cold temperature conditions, if any.

**6.2.13.7 Unusual Cold Temperature Operations Outside Of The US.** It is particularly important to note these temperature effects when operating outside of the US. Not all states necessarily address temperature compensation within instrument procedure development or in airspace procedure planning. If a flight crew or operator is in doubt regarding safe obstacle clearance, additional margin should be provided (e.g., requested from ATS, if applicable). Operators may elect to coordinate with authorities or ATS facilities in countries outside of the US which have unusually cold temperatures to determine which procedure specified altitudes include extreme cold temperature considerations, if any, and which do not. If a pilot is in doubt as to safe altitude clearance, corrections should be considered and applied, and ATS should be advised of the use of corrected altitudes, if applicable.

Where temperature constraints are placed on instrument approach procedures, operators and pilots should be familiar with and properly apply those constraints. Pilots and operators should also be familiar with any temperature correction table(s) provided by the "State of the Aerodrome" (ICAO), or aircraft manufacturer. For FMS, pilots should be familiar with any temperature correction methods that apply to proper FMS use, if provided.

**6.2.13.8 Use of Standard Cold Temperature Correction Table (Table 6.2.13-1).**

Extreme cold temperature corrections may be made within the US, or by US operators when flying internationally, in accordance with the standard temperature correction table shown in Table 6.2.13-1, or through an equivalent table. International operators flying to the US (e.g., FAR 129) may use methods acceptable to the authority of the State of the Operator, or methods equivalent to those found acceptable for US operators by FAA.

Table 6.2.13-1 provides altitude correction values in feet, related to reported airport surface temperature, to be added to various published instrument procedure related altitudes. The amount of altitude correction to be applied depends on the height of the published segment above the airport.

For example, using Table 6.2.13-1, with the following conditions:

- a reported airport surface temperature of -30C, and
- a published instrument procedure segment altitude of 1500 feet above the airport elevation,

an altitude correction of 280 feet would apply (see highlighted values in Table 6.2.13-1).

**6.2.13.9 Use of Other Cold Temperature Correction Tables.** In the event that different cold temperature altitude correction table(s) or methods are provided by a "State of the Aerodrome", an aircraft manufacturer, ICAO, another authority for that State, or by the operator (e.g., simplified table(s) or methods), pilots or operators may use that alternate table or method in lieu of Table 6.2.13-1. The alternate table(s) or methods should, however, assure suitable terrain and obstacle clearance, and its use should be compatible with any applicable ATS procedure or clearance.

**6.2.13.10 Altimeter settings.** Pilots and operators should be familiar with the proper altimeter settings to use, and take necessary precautions to switch altimeter settings at appropriate times or locations, considering possible multiple sources for altimeter settings including ATS issued altimeter settings, company or airport reported settings, or settings broadcast over ATIS, or automated settings received by radio based on AWOS, or ASOS.

**6.2.13.11 Precautions For Altimeter settings That Are Not Recent.** Pilots and operators should also take necessary precautions when using altimeter settings that may not be recent, or settings from remote locations, or rapidly varying settings, particular at times when pressure is reported or is expected to be rapidly decreasing.

**6.2.13.12 Precautions For Unusually High or Low Temperatures or High or Low Pressures.** Aircraft performance or procedure adjustments may need to be considered for unusually high or low temperatures or high or low pressures (e.g. temperatures or pressures above or below available AFM data). In such situations operators may need to request suitable additional information or AFM provisions from the manufacturer, if temperatures or pressures exceed available AFM information or limitations. Data may be provided by the aircraft manufacturer or other approved source (e.g., if the aircraft manufacturer no longer exists or does not support the aircraft type) for such unusual temperatures or surface pressures. In addition to acquiring the necessary data and revised limitations, these situations can also be an important additional consideration for go-around or missed approach assessment.

# Cold Temperature Altitude Corrections

**Note:** Values are to be added to published altitudes.

| Arpt Temp (°C) | Height Above Altimeter Source (feet) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | **1500** | 2000 | 3000 | 4000 | 5000 |
| 0 | 20 | 20 | 30 | 30 | 40 | 40 | 50 | 50 | 60 | 90 | 120 | 170 | 230 | 290 |
| -10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 150 | 200 | 290 | 390 | 490 |
| -20 | 30 | 50 | 60 | 70 | 90 | 100 | 120 | 130 | 140 | 210 | 280 | 430 | 570 | 710 |
| **-30** | 40 | 60 | 80 | 100 | 120 | 130 | 150 | 170 | 190 | **280** | 380 | 570 | 760 | 950 |
| -40 | 50 | 80 | 100 | 120 | 150 | 170 | 190 | 220 | 240 | 360 | 480 | 720 | 970 | 1210 |
| -50 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 450 | 600 | 890 | 1190 | 1500 |

**Table 6.2.13-1**

**6.2.14 Metric Altitudes**
The operator should address appropriate flight crew and dispatch procedures (if applicable) for identification of and appropriate setting and use of altimeters, altitude alert systems, and altitude reference bugs for metric altitude use (if applicable). This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings, change over points, and callouts as used by that operator, and as applicable to the metric altitude routes and procedures used.

**6.2.15 International "Approach Procedure Title" Requirements for or Limitations on Navaid Use**
The operator should address appropriate flight crew and dispatch procedures (if applicable) for identification of and appropriate use of international approach procedures which may or may not have all necessary navaids listed in the "procedure title" (e.g., NDB ILS Rwy 16). For some of these procedures, navaids may be required which are not necessarily shown in the procedure title. For these procedures the operator should assure that appropriate airborne equipment is operating for dispatch (if applicable), and crews should verify that appropriate navigation equipment is operating to safely conduct the approach and missed approach. Where approved substitutions are approved for U.S. operators (e.g., FMS based RNAV for NDB, VOR, or DME, or GPS for NDB) the operator should assure flight crews are familiar with substitutions allowable for that region, state or procedure.

**6.2.16 "U.S. TERPS" or "ICAO PANS-OPS" Obstacle Clearance Procedural Protection Limitations**
The operator should be aware that U.S. Standards for Terminal Instrument Procedures (TERPS) and "ICAO PANS-OPS" based instrument procedures principally address normal operations, including flight above DA(H) or MDA(H), and above any specified or assumed climb gradients. Operations in non-normal configurations or at unusual speeds (e.g., operations with an engine inoperative, particularly for twin engine aircraft, or in unusual flap or flight control configurations) do not necessarily assure compliance with climb gradients assumed for TERPS or PANS-OPS based standard procedures. Accordingly operators, flightcrews and dispatchers (if applicable) should consider any necessary aircraft type specific or weight/altitude/temperature (WAT) specific procedures (e.g., similar to "T-Procedures" for takeoff) that may be necessary to assure safe obstacle clearance, for at least the following situations:

1) Engine failure prior to initiation of or during approach or missed approach,
2) Balked landing or go-around from below DA(H) or MDA(H) (e.g., as for inadvertent loss of visual reference)
3) Any special precautions that may be needed if a crew follows a published missed approach procedure or ATS instruction for a turn from below DA(H) or MDA(H), and before climbing to a safe altitude protected by the procedure or MVA,
4) Any necessary consideration of an associated "IFR departure procedure" as an aid to assure safe obstacle clearance, if initiating a go-around from below DA(H), MDA(H), or during a circling approach,
5) Any special limitations that may be necessary for safe operations into FAR121.445 designated airports. (e.g., Reno, NV [KRNO]).

**6.2.17 Navigation Reference Datum Compatibility (e.g.,WGS-84/Other Datum)**

Outside the U.S., it is important for operators using FMS, GPS and RNAV to be aware of , and where necessary, take precautions to address potential differences in the Navigation Data Base (NDB) "reference datum" used by their aircraft's navigation system, and the datum used locally by States for aeronautical data (e.g., navaid locations, runway waypoint locations) and specification of instrument procedures.

This is important to preclude significant navigation errors. If not appropriately addressed, aircraft actual position may significantly differ from indicated position. Aircraft may experience incorrect FMS position updating, may fly to an incorrect geographic location for a waypoint, navaid, or runway, may violate obstacle clearance during approach or missed approach, or may complete an instrument procedure displaced from the airport or runway intended. Significant map shifts can occur if FMS position estimates are based on use of a navaid using a different reference datum than the aircraft's NDB presumes. Similarly GPS stand alone systems, while accurately flying to locations specified in a WGS-84 coordinate frame, may not necessarily fly the path over the ground intended by the procedure if the specification of that path uses a datum significantly different than WGS-84. This also can be important when flying with a navigation data base using WGS-84 as the basis for a procedure, but the aircraft is not using GPS or GPS updating, and is depending on local navaid updating with those navaids referenced to a different datum (e.g., as for a GPS inoperative MEL dispatch case with FMS).

For Category I or II procedures, the issue of use of an appropriate Navigation "Reference Datum" principally applies to flying procedures as follows:

- RNAV approach or missed approach procedures, or
- RNAV Initial or intermediate segments ILS or MLS procedures, or
- RNAV missed approach segments ILS or MLS procedures.

The final approach segment of ILS or MLS typically is not adversely affected by a difference in reference datum.

GLS or RNP procedures, while depending on specification of an appropriate reference datum for final approach, are protected through other criteria to assure consistent navigation.

Information about the Navigation Reference Datum used in a particular location outside of the United States is typically available on the internet. An example of a web site containing this information may be found at:

**http://www.jeppesen.com/wgs84.html**

Accordingly, when outside United States airspace and when WGS-84 is not used as the reference datum locally for navaids or procedures, or a reference datum equivalent to WGS-84 is not used, and RNAV segments are flown as part of an instrument approach or missed approach procedure for:
- FMS equipped aircraft,
- FMS equipped aircraft using GPS updating, or
- GPS "stand alone" equipped aircraft

operators should take suitable precautions, as described below.

**a. Aircraft Equipped With FMS Having GPS Updating Capability, or Equipped With "GPS Stand Alone" Navigation Systems**

For aircraft having FMS capability with GPS updating, or a "GPS Stand Alone" navigation systems, for each approach outside the U.S. where the local datum is not WGS-84, or WGS-84 equivalent, or where the operator is uncertain as to whether the local datum is significantly different than WGS-84, the operator should take one or more of the following precautions, as necessary:

1) Verify that the datum is WGS-84, or equivalent,

2) Conduct an assessment of the difference in the datum used, to determine that any difference is not significant for the procedures to be flown,

3) Develop and use special RNAV procedure segments or aeronautical data referenced to WGS-84 or equivalent, as necessary,

4) Manually inhibit GPS updating of the FMS while flying the approach, or segments of the approach affected by the difference in reference datum,

5) Only use FMS or GPS Stand Alone systems to fly pertinent RNAV segments of the approach where it is possible to use other navaid raw data to confirm correct aircraft position along the flight path,

6) Conduct simulation verification, or in-flight verification or confirmation of suitable navigation performance,

7) Preclude FMS or GPS use on segments of the approach affected by the difference in reference datum, or

8) Use any other method proposed by the operator, and found acceptable to FAA, to assure that a difference in the NDB Reference Datum from the local datum does not cause loss of navigation integrity.

For GLS or RNP procedures or procedure segments, since the reference datum is consistent with WGS-84 by procedure design, operators of aircraft using GPS updating of FMS need not apply the special precautions listed above, unless otherwise advised (e.g., by NOTAM or equivalent).

**b. FMS Aircraft That Do Not Have GPS Updating Capability.**

While possible, FMS equipped aircraft that do not have GPS updating capability may be less likely to experience this particular datum reference difference issue. This is because navigation data bases, local navaids, and local instrument procedures typically address and resolve datum issues consistently on a local basis, and in a consistent manner within the locally used coordinate frame of reference. However, even though the datum difference issue may be less likely, it nonetheless may occur. Precautions should be applied by operators, as necessary, if there is significant doubt as to Navigation Data Base datum differences.

The precautions listed above in item a. should not be interpreted to discourage GPS installation and use. GPS updating of FMS can significantly increase both navigation accuracy and integrity, and reduce the risk of other types of navigation errors, including map shifts, yielding a significant safety increase.

**6.2.18 Alternative Use Of FAA/JAA Harmonized Minima.**

This AC provides for use of optional "FAA/JAA harmonized operating minima" when authorized by operations specifications, in lieu of otherwise published minima based on U.S. TERPS or ICAO PANS-Ops. Use of these minima are limited to use within the U.S., within any JAA (European) State that authorizes use of these minima or equivalent, or in other States which accept or apply FAA or JAA criteria. These minima have been determined to be acceptable for use by U.S. operators or JAA supervised operators within the U.S. who have implemented applicable provisions and criteria of the main body of this Advisory Circular or equivalent.

These minima provide for a single table for Aerodrome Operating Minima regardless of approach type, and are intended for use by aircraft and procedures which are based on a stabilised descent path to the runway (e.g., using an xLS glide slope, VNAV, or other specifically approved method for maintaining a constant vertical descent path or rate during final approach). Use of minima in this table for other procedures not using a glide slope or constant VNAV descent path to minima is considered only on a case by case basis, by FAA.

The harmonized minima are intended to cover all categories of straight-in approach procedures including xLS (e.g., ILS GLS, MLS) and approaches other than xLS (e.g., RNAV, LOC, BCRS, VOR, NDB). Any procedure based on U.S. TERPS or ICAO PANS-OPS, or special procedures otherwise approved by FAA are eligible to use these harmonized minima.

Approaches with glide slope angles or VNAV descent paths in excess of 3.77 degrees, or special procedures at certain airports which require specific knowledge or training, are not typically eligible for use of these special approach minima.

The FAA/JAA Harmonized Approach minima which may alternately be approved through Operations-Specifications for use by U.S. operators, or JAA supervised operators, or equivalent authority/operators determined acceptable by FAA (e.g., Canada), are as listed in Appendix 8.

**6.2.19 Assessment of Threshold Crossing Height (TCH), Approach Descent Gradient, and Runway Slope.**

Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to assure satisfactory Threshold Crossing Height (TCH) for the type of aircraft to be flown (see 5.12.3 and 5.12.4). Typically TCHs of less than 48' should not be used by wide body air carrier aircraft without special review by the operator.

Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to assure that final approach descent gradients specified are appropriate for the type of aircraft to be flown, and for conditions expected to be encountered (e.g., engine-out flap settings and speeds, anti-ice operating). For facility, obstacle, or terrain constraints, certain airports served by air carrier aircraft have unusually steep gradients

(Stephenville, Nfld. - CYJT) or unusually shallow gradients (Kodiak, Ak - PADQ) that may have operational consequence for certain aircraft types.

Under extreme cold temperature conditions certain VNAV paths may be more shallow than normal, and under extreme high temperatures these VNAV paths may be steeper than normal (see Section 6.2.13). In either case the paths may not closely align with fixed visual aids such as VASI/PAPI.

Certain runways have unusual general slope, or complex varying slope that should be assessed by the operator for pilot awareness, or for operational consequence (e.g., operator specifies that the aircraft must touchdown by a certain point on the runway, or the last portion of the runway is not visible during flare in the touchdown zone due to changing slope).

**7. TRAINING AND CREW QUALIFICATION.** Training and crew qualification programs pertinent to Category I, Category II, or lower than standard takeoff minima should include appropriate ground training (e.g., knowledge assurance) and flight training (e.g., skill or maneuver experience in simulation or an aircraft) to assure safe aircraft operation for instrument procedures and low visibility operations in normal, rare normal (e.g., winds, turbulence, restricted visibility), and specified non-normal conditions (e.g., engine or various systems inoperative). Although training is not required for part 125, operators are encouraged to prepare a training and qualification program for all crewmembers in accordance with this section.

This is typically accomplished through appropriately addressing initial qualification, recurrent qualification, upgrade qualification, differences qualification, recency of experience, and re-qualification. The operators program should provide appropriate training and qualification for each pilot in command, second in command and any other pilot or flight crewmember expected to have knowledge of or perform duties related to Category I or Category II landing operations (e.g., Flight engineer, augmented crewmember).

Each pilot-in-command (PIC), and each other pilot or dispatcher, if applicable, having duties related to flight planning or use of Category I or Category II instrument procedures is expected to have comprehensive knowledge of areas described in section 7.1 below. Each pilot expected to perform instrument procedures in normal or specified non-normal operations or perform duties associated with those procedures, should have successfully demonstrated the necessary skills in accomplishing those designated maneuvers or procedures as shown in sections 7.2 through 7.4 below. Demonstration of skill in performing instrument procedures typically is accomplished through simulator training, checking, or during line operating experience or evaluations. Pilots other than a PIC or SIC may only be expected to perform those relevant duties, procedures or maneuvers related to instrument procedures that are applicable to their own crew position or assigned duties (e.g. international relief officers).

**7.1. General Knowledge (Ground) Training for All Weather Operations (AWO).** Appropriate ground training should be conducted suitable for the "All weather Operations", instrument procedures, aircraft type(s) or variants, crew positions, airborne systems, NAVAIDs, and ground systems used.

Topics should be addressed to include at least those listed in sections 7.1.1 through 7.1.3 below, and be addressed or tailored to suit application to initial qualification, recurrent qualification, re-qualification, upgrade or differences qualification, as applicable.

Topics should be addressed for each PIC and any other pilots having assigned duties (e.g., SIC) as a PF or PNF during conduct of instrument approach procedures. When duties are specifically assigned to a PF or PNF (e.g., monitored approach, Category II), only those duties applicable to the assigned crew position need be addressed for that crew position. When instrument approach related duties are specifically assigned to other than the PIC or SIC, such as a flight engineer or relief pilot duties applicable to the assigned crew position should be addressed. When flight crewmembers other than a PIC or SIC are not assigned duties associated with an instrument approach procedure but are expected to be present on the flight deck during an instrument approach, it is recommended, but not required, that they also receive suitable academic training.

Acceptable methods to address ground training topics include classroom instruction, self guided slide/tape presentation, or computer based instruction, or self-instruction using appropriate reference materials.

If the method of satisfying ground training requirements is exclusively through self guided learning or review from appropriate reference materials (e.g., flightcrew operating manual, Aeronautical Information Manual, and commercially available instrument procedure charts), the operator should use some clearly identified method (e.g., periodic written examination) to verify that each pilot has acquired or has retained the necessary knowledge.

**7.1.1. Ground Systems and NAVAIDs for Category I or Category II.** Ground systems and NAVAIDs are considered to include characteristics of the airport, electronic navigation aids, lighting, marking and other systems (e.g., RVR) and any other relevant information necessary for safe Category I or Category II landing or low visibility takeoff operations.

The training and qualification program should appropriately address the operational characteristics, capabilities and limitations of at least each of the following:

**1) NAVAIDs.** The navigation systems or NAVAIDs to be used, such as the instrument landing system (ILS) with its associated critical area protection criteria, GPS Landing System (GLS), or Microwave Landing System (MLS) characteristics, as applicable, marker beacons, VOR, DME, NDB, DME, compass locators or other relevant systems should be addressed to the extent necessary for safe operations. If area navigation systems, or other non-ground based NAVAID systems (e.g., GNSS, LORAN) are used, any characteristics or constraints regarding that method of navigation or associated supporting elements (e.g., GBAS, WAAS), must be addressed.

**2) Visual aids.** Visual aids include approach lighting system, touch down zone, centerline lighting, runway edge lighting, taxiway lighting, standby power for lighting and any other lighting systems that might be relevant to a Category I or Category II environment, such as pilot control of lighting aids, or coding of the center line lighting for distance remaining, and lighting for displaced thresholds, land and hold short lighting, or other relevant configurations should be addressed.

**3) Runways and Taxiways.** The runway and taxi way characteristics concerning width, safety areas, obstacle free zones, markings, hold lines, signs, holding spots, runway slope, suitability of TCH, unusual friction, grooving, or PFC characteristics, critical area protection areas, or taxi way position markings, runway distance remaining markings and runway distance remaining signs should be addressed.

**4) Meteorological Information.** METARs, TAFs, visibility reporting, Transmissometers systems, including RVR locations, readout increments, sensitivity to lighting levels set for the runway edge lights, variation in the significance of reported values during international operations, controlling and advisory status of readouts, and requirements when transmissometers become inoperative. Appropriate use of Temperatures in C or F, conversion of temperatures between C and F. Appropriate use of pressure information including altimeter settings in units of HPa or inches, QNE, QNH, QFE (if applicable). Appropriate use of Transition Level and Transition Altitude. Appropriate interpretation and use of reported wind and gust information, in true or magnetic direction, as applicable to the source and circumstance.

**5) NOTAMs and other aeronautical information.** Facility status, proper interpretation of outage reports for lighting components, standby power, or other factors and proper application of NOTAMs regarding the initiation of Category I or Category II approaches or initiation of a low visibility takeoff.

**6) Flight Planning and Flight Procedures related to Inoperative or Unsuitable NAVAIDs.** When NAVAID position updating is used in support of area navigation position determination (e.g., VOR, VOR-DME, DME-DME, GNSS updating), operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or updating method within the airborne navigation system. This is especially true for NAVAID failure conditions that are probable to cause a significant map (position) shift (e.g., movement of a NAVAID to a new location without corresponding update of the NAVAID position in a database, significant numbers of space vehicle outages, or areas of interference).

**7.1.2. The Airborne System.** The training and qualification program should address the characteristics, capabilities, and limitations of each appropriate airborne system element applicable to Category I or Category II landing including the following:

1) **Flight guidance system.** The flight guidance system, including appropriate modes to be used for different circumstances or procedures
(e.g., APPROACH, HDG, V/S, LNAV/VNAV), and any associated landing system or landing and roll out system, or go-around capability, if applicable (e.g., autopilot, autoland),

2) **Flight director system.** The flight director system, including appropriate modes to be used for different circumstances or procedures
(e.g., APPROACH, HDG, V/S, LNAV/VNAV), and including any associated landing or landing and roll out capability, or go-around capability, if applicable (e.g., HGS),

3) **Automatic throttle**. The automatic throttle control system, if applicable. Mixed mode autoflight/autothrottle operation should be addressed (e.g., manual flight, but with autothrottles on, or vice versa), if pertinent to the aircraft type,

4) **Displays**. Situation information displays, as applicable, including any applicable limits for acceptable approach performance to continue an approach, flare, rollout, or go-around (e.g., typically 1/2 dot or less lateral or vertical displacement below
500 feet HAT down to DA(H), and

5) **Status, Alerting and Warning Displays.** Other associated instrumentation and displays, as applicable, including any monitoring displays, status displays, mode annunciation displays, failure or warning annunciations and associated system status displays that may be relevant.

6) **Means for determining DA(H) or MDA(H).**
The means for determining DA(H) or MDA(H) as follows:

DA(H) as applicable to the particular Category I ILS, GLS, or MLS procedure (e.g., as an applicable DA, or Marker Beacon substitute for a DA when authorized),

DA(H) as applicable to the particular Category I RNAV or RNAV RNP procedure with VNAV (e.g., as an applicable DA),

MDA(H) as applicable to the particular Category I procedure other than ILS, GLS, or MLS (e.g., as an applicable MDA, and any associated missed approach point), and

DA(H) as applicable to the particular Category II ILS, GLS, or MLS procedure (e.g., as an applicable DH, or Marker Beacon substitute for a DH, when authorized).

7) **Other flight deck systems**. Other flight deck systems operations or use, as may be related to low visibility operations (e.g., autobrakes, autospoilers), and any associated limitations, characteristics, or constraints (e.g., touchdown pitchup or pitchdown tendency of certain autospoiler or autobrake settings or non-normal conditions, time delays, auto-deactivation features with go-around).

8) **Other aircraft characteristics.** Any system or aircraft characteristics that may be relevant to Category I or Category II operations, such as cockpit visibility cutoff angles and the effect on cockpit visibility of proper eye height, seat position or instrument lighting intensities related to transition through areas of varying brightness visual conditions change. Crews should be aware of the effects on flight deck visibility related to use of different flap settings, approach speeds. Minimum usable TCH and minimum or maximum final approach descent gradients should be addressed, if applicable.

9) **Lighting.** Proper use of various landing, taxi, turnoff, wing, logo, or strobe lights for approach visibility, taxi, or collision avoidance conspicuity.

10) **Rain Removal and De-fog.** Proper procedures for use of rain removal/defog (e.g., windshield wipers). If windshield defog, anti-ice, or de-icing systems affect forward visibility, crews should be aware of those effects and be familiar with proper settings for use of that equipment related to low visibility landing.

11) **Course and Frequency Selection.** For automatic or manual systems which require crew input for parameters such as inbound course or automatic or manually tuned navigation frequencies, the crew should be aware of the importance and significance of any incorrect selections or settings, if not obvious, to assure appropriate system performance.

12) **Environmental Limits.** Description of the limits to which acceptable system performance has been demonstrated for headwind, tailwind, crosswind, and wind shear as applicable, and recognition of unacceptable performance in the case of adverse weather (e.g., windshear, turbulence).

13) **Non-normal or failure conditions.** Recognition and response to pertinent non-normal or failure conditions, and related non-normal procedure and checklist use for flight guidance, instrument, and supporting systems (electrical, hydraulic, and flight control systems).

14) **Go-Around.** Proper airborne system use for go-around, including consideration of height loss during transition to a go-around, performance assurance for obstacle clearance, management of any necessary mode changes, and assurance of appropriate vertical and lateral flight path tracking.

As applicable, the operator may consult the CHDO/POI to assure that information presented by the operator about any training or qualification items or issues referenced above, or any additional issues pertinent to the type aircraft or system used, are consistent with the pertinent FAA Flight Standardization Board (FSB) Report for the applicable aircraft type.

**7.1.3. Flight Procedures, Operations Specifications and Other Information.**

1). **FARs and Op-Specs.** Pilots, and dispatchers if applicable, should be familiar with FAA regulations pertinent to their operation (e.g., sections 91.175, 121.651, 125.381 and 135.225) and OpSpecs applicable to Category I or Category II landing, or lower than standard takeoff minima, as applicable.

2). **Crew Duties.** Pilots should be familiar with appropriate crew duties, monitoring assignments, transfer of control during normal operations using a "monitored approach" appropriate automatic or crew initiated call-outs to be used, proper use of standard instrument approach procedures, special instrument approach procedures, applicable minima for normal configurations or for alternate or failure configurations and reversion to higher minima in the event of failures.

3). **Visibility and RVR.** Pilots, and dispatchers if applicable, should be familiar with proper application of meteorological visibility, METARs, TAFs, runway visual range (RVR), RVV (if applicable), including their respective use and limitations, the determination of controlling RVR and advisory RVR, required transmissometers, appropriate light settings for correct RVR readouts and proper determination of RVR values reported at foreign facilities. Pilots should be familiar with any authorized methods for pilot assessment and reporting of visibility at non-U.S. facilities.

4). **Procedures and Charts.** Pilots, and dispatchers if applicable, should be familiar with the proper use of instrument procedures and charts including application of DA(H) and MDA(H), and when to use DA, DH, or an equivalent (e.g., OCA (H)), or MDA as applicable, including proper use and setting of barometric or radar altimeter bugs, use of the inner marker where authorized or required due to irregular underlying terrain and appropriate altimeter setting procedures for the barometric altimeter consistent with the operators practice of using either QNH or QFE, and if applicable.

Pilots should be aware of when to make suitable cold weather temperature corrections for altimeter systems and procedures, if necessary.

5). **Visual references**. Pilots should be familiar with the availability and limitations of visual references encountered, both on approach before and after DA(H), if a DA or DH is applicable. Pilots should be familiar with the expected visual references likely to be encountered. Pilots should be familiar with procedures for an unexpected deterioration of conditions to less than the minimum visibility specified for the procedure during an approach, flare or roll out including the proper response to a loss of visual reference or a reduction of visual reference below the specified values when using a DA(H) or MDA(H) and prior to the time that the aircraft touches down. The operator should provide some means of demonstrating the expected visual references where the weather is at acceptable minimum conditions and the expected sequence of visual queues during an approach in which the visibility is at or above the specified landing minimums. This may be done using simulation, video presentation of simulated landings or actual landings, slides showing expected visual references, computer based reproductions of expected visual references or other means acceptable to the FAA.

6). **Visual Transition.** Procedures should be addressed for transitioning from non-visual to visual flight for both the pilot in command, second in command, as well as the pilot flying and pilot not flying during the approach. For systems that include electronic monitoring displays, as described in item 5 above, procedures for transitioning from those monitoring displays to external visual references should be addressed.

7). **Unacceptable Displacements.** Pilots should be familiar with the recognition of the limits of acceptable aircraft position and flight path tracking during approach, flare and if applicable roll out. This should be addressed using appropriate displays or annunciations for the aircraft type.

8). **Environmental effects**. Environmental effects should be addressed. Environmental effects include appropriate constraints for head winds, tail winds, cross winds, and the effect of vertical and horizontal wind shear on automatic systems, flight directors, or other system (e.g., HGS) performance. For systems such as head-up displays which have a limited field of view or synthetic reference systems (e.g., EVS or SVS) pilots should be familiar with the display limitations of these systems and expected crew actions in the event that the aircraft reaches or exceeds a display limit capability.

Extreme temperature or pressure effects should be considered, if necessary.

9). **Operator Policies.** Pilots, and dispatchers if applicable, should be familiar with the operators policies and procedures concerning any constraints applicable to Category I or Category II landings, or low visibility takeoff including constraints for operations on contaminated or cluttered runways. Procedures to be used when obscuring of appropriate lighting or markings occurs, and limits should be noted for operations on slippery or icy runways regarding both directional control and stopping performance. Pilots, and dispatchers if applicable, should be familiar with appropriate constraints related to use of braking friction reports. Pilots, and dispatchers if applicable, should be familiar with the method of providing braking friction reports applicable to each airport having instrument landing operations.

10). **Response to aircraft or system failures**. Pilots should be familiar with the recognition and proper reaction to significant aircraft system failures experienced prior to and after reaching the final approach fix and experienced prior to and after reaching DA(H), as applicable. Expected crew response to failures prior to touchdown should be addressed, particularly for Category II operations.

11). **Ground or navigation system faults**. Pilots are expected to appropriately recognize and react to ground or navigation system faults, failures or abnormalities at any point during the approach, before and after passing DA(H) and in the event an abnormality or failure which occurs after touchdown. Pilots should be familiar with appropriate go-around techniques, systems to be used either automatically or manually, consequences of failures on go-around systems which may be used, the expected height loss during a manual or automatic go around considering various initiation altitudes, and appropriate consideration for obstacle clearance in the event that a missed approach must be initiated below DA(H).

12). **Navigation anomalies or discrepancies.** Pilots, and dispatchers if applicable, should be familiar with the need to report navigation system anomalies or discrepancies, or failures of approach lights, runway lights, touchdown zone lights, center line lights or any other discrepancies which could be pertinent to subsequent Category I or Category II operations.

13). **International Procedures.** Pilots, and dispatchers if applicable, should be familiar with any applicable international procedures including application of OCA, OCH, the applicable State AIP, or regional supplements (if not otherwise addressed by the operator in the FCOM or equivalent), pertinent excerpts from ICAO references (e.g., Manual for All Weather Operations - ICAO DOC 9365AN/910). Regulatory requirements and responsibilities at non-U.S. international airports (e.g., approach ban and "look see" provisions).

14). **Performance and Obstacle Clearance**. Pilots, and dispatchers if applicable, should be familiar with any applicable aircraft performance or weight limit information to assure safe obstacle clearance for "all engine", or "engine inoperative" missed approach, or rejected landing. Applicable performance information should consider applicable flap settings to be used, go-around procedures, acceleration segments if applicable, transition at any time following an engine failure between the specified "all-engine lateral flight path" (or radar vectors) and any specified "engine-inoperative lateral flight path", using acceptable flap retraction and cleanup height procedures.

15). **Flight Plans and Equipment Classification**. Pilots, and dispatchers if applicable, should be familiar with use of appropriate flight plan equipment classifications [e.g., Required System Performance (RSP)] affecting eligibility for various takeoff or landing procedures (e.g., flight plan /F, /E designations), and proper alternate airport identification and use, including any takeoff, en route ETOPS, or destination alternates, as applicable.

16) **EVS, SVS, or ILM.** When a synthetic reference system such as a "synthetic vision system" (SVS) or "enhanced vision system" (EVS) or "Independent Landing Monitor" (ILM) system is used, pilots should be familiar with the interpretation of the displays to assure proper identification of the runway and proper positioning of the aircraft relative to continuation of the approach to a landing. Pilots should be briefed on the limitations of these systems for use in various weather conditions and specific information may need to be provided on a site-specific basis to assure that misidentification of taxiways or other adjacent runways does not occur when using such systems.

**7.2. Maneuver or Procedure (Flight) Training for All Weather Operations (AWO).**

**a. Aircraft Or Flight Simulator Use.** Maneuver/Procedure (Flight) training and evaluation should be provided, and should use appropriate simulation capability. If simulation capability is not available, training or evaluation may be accomplished partially with training devices, or partially or completely in an aircraft. However, when training or evaluation is done using training devices, or with simulators with limited capability (e.g., not Level C or D), or with an aircraft, additional factors or techniques (e.g., use of CBT) may need to be considered by the operator to assure effective training.

**b. Addressing Applicable Regulations.** Maneuver or procedure training should generally address applicable part 121 Appendix E or F provisions, an Approved AQP Program as applicable, approach and landing events specified in part 61, relevant FAA Order 8400.10 airman certification takeoff and landing provisions, FAA Order 8700.1 for FAR Part 125 competency or instrument checks, or FAA ATPC Practical Test Standards (PTS) as applicable, as described or credited below.

**c. Types Of Procedures And Conditions To Be Addressed.** Maneuvers and procedures trained should be keyed to the types of instrument procedures used by the operator, the environment in which they are flown, and any special considerations that may apply to their safe application. Operating policies, procedures, and documentation representative of that applicable to the particular operator should be used. Maneuver and Procedure Training and any necessary evaluation should assure that instrument procedures can be safely flown considering at least the following factors, as applicable to the specific operator:

1) Types of Instrument Procedures used (Standard and Special, if applicable),

2) That operator’s manuals, charts, and checklists,

3) Aircraft type(s) and variants flown,

4) Flight guidance system(s) used,

5) NAVAID(s) and Visual aids used,

6) Flightcrew procedures used (e.g., PF/PNF duties, monitored approach, callouts),

7) Airport characteristics typically experienced (e.g., Visual aids, transition level, air traffic procedures, Met procedures, signs and markings, unusual airport features (elevations, slope) as applicable),

8) Runway characteristics typically experienced (e.g., representative field lengths, grooving, marking),

9) Nearby critical terrain or obstruction environment, if applicable,

10) Relevant environmental conditions (e.g., wind, turbulence, shear, visibility and ceiling conditions, slippery runways, rain or snow effects on visibility),

11) Lowest Category I or Category II straight-in, or Category I circling minima as applicable, and

12) Other relevant AWO characteristics (e.g., special instrument procedures).

**d. Use of Part 121.Appendix H Level C or D Simulators.** When simulation (e.g., part 121.Appendix H level C or D) is the primary method used for flight training or evaluation for takeoff, approach and landing procedures, appropriate normal, non-normal, and environmental conditions (relevant wind, turbulence, visibility and ceiling conditions) should be simulated. In this instance, training and evaluation need only be conducted using applicable landing minima and relevant and representative procedures and conditions (e.g., a representative mix of day, night, dusk, variable/patchy conditions, representative temperatures, landing runway altitudes, precipitation conditions, turbulence, and icing conditions). Multiple requirements for maneuvers may be combined at the discretion of the POI/APM/CMO/CMU, subject to the constraints below (e.g., to preclude the need to repeat various Category I/II/III, approach scenarios for normal approaches, approaches with an engine(s) out, missed approach, landing, rejected landing, and various go-around events). The training benefit of realistic simulation is acknowledged, and credit for use of a representative sample of conditions to be flown, directly using pertinent minima, is considered to be acceptable. Accordingly, when level C or D simulation is used, only a sample of procedural types, environmental conditions, successful crew performance, and other factors listed in c. above need be assessed. However, when such credit for combining events is permitted, the operator and CMO/CMU/POI/APM should nonetheless ensure that the program used leads to flightcrews reliably performing the necessary low visibility procedures under both normal and anticipated non-normal conditions in line service. Acceptable numbers and types of training or demonstration instrument approach procedure events for various types of training or checking or qualification programs are listed in sections 7.2.1 through 7.2.7 below.

In instances where Level C or D Simulation is typically used in accordance with this provision, but the level of simulation capability is temporarily degraded to Level A or B, the operator with CMO concurrence may nonetheless apply provisions of this paragraph on a temporarily basis, until the simulation capability can be returned to level C or D status.

**e. Use of Simulators other than Part 121 Appendix H Level C or D, use of Training Devices, or use of an Aircraft.** When part 121.Appendix H level C or D simulation (or equivalent) is not used for All Weather Operations (AWO) Qualification (e.g., when an aircraft is used, or a training device(s) level 2 through 7, or visual simulator, or non-visual simulator, or Level A or B simulator, or a simulator qualified for Level C or D but used as an FBS is used) certain restrictions and additional provisions may apply to training or qualification, as follows:

1) The POI or CMO/CMU may require that during training or evaluations the flightcrew demonstrate satisfactory lateral and vertical flight path tracking performance, to an appropriate tolerance, and to assure flight path stability after passing DA(H). This is to address the possible lack of visual reference or external environmental disturbances that may exist in real operations but that may be minimal or absent during training or testing in limited capability simulators or simulation devices (e.g., due to lack of visual reference, turbulence or other disturbances being faithfully represented).

2) The POI or CMO/CMU may require that additional procedures or combinations of procedures be demonstrated, or that limitations apply to credits allowed by this AC in terms of credit for combining maneuvers or types of procedures trained, maneuvers demonstrated, or other events evaluated (e.g., for combinations of various Category I, II, III procedures for ILS, VOR, VOR/DME, NDB, Back Course Localizer, engine inoperative missed approach or landing procedures).

3) The POI or CMO/CMU may require additional training or checking event items beyond those identified in this AC below, or those addressed only generically in part 121 Appendix E or F, or in part 61 Appendix A (e.g., providing for HUD or autoland qualification where part 121 or 91 only make general reference to items like other special characteristics as necessary),

4) When using an aircraft for training or testing, the POI or CMO/CMU may require that provision be made for use of a view limiting device for any necessary competency demonstrations. This is particularly applicable to any evaluation of a pilot that has not previously qualified to fly a similar class of aircraft (e.g., large turbojet aircraft), or for a pilot that does not have significant instrument experience beyond that necessary to satisfy minimums for issuance of an FAA commercial pilot's license with instrument rating.

5) For use of Level A or B Simulation in lieu of Level C or D Simulation that is temporarily not available, see paragraph 7.2 d. above.

**f. Flight Training Maneuvers for Category I or II Landings.**
Maneuvers may be addressed individually as a respective Category I or Category II maneuver, or an appropriate sample of Category I and Category II maneuvers may be trained and evaluated, if crews are to be both Category I and II qualified. When flightcrews are authorized to use minima for Category III, as well as Category II, samples of maneuvers selected to be performed for training and evaluation may be from appropriate combinations of Category I, II, and III procedures. When found acceptable to the CHDO/POI, each maneuver need not be repeated for each Category of landing weather minima to be authorized.

Flight training for Category I or Category II landing should address at least the following maneuvers:

1). **Normal landings**. Normal landings at the lowest applicable Category I or Category II minima, using representative autoflight configurations or combinations of configurations authorized for use (e.g., flight director, autopilot, autothrottles),

2). **Missed approach.** A missed approach from the lowest applicable DA(H) and MDA(H), (may be combined with other maneuvers),

3). **Balked landing**. A balked landing or missed approach from a low altitude that could result in a touchdown during go-around (balked landing or rejected landing - may be combined with other maneuvers),

4). **System or Navaid Failures.** Appropriate aircraft and ground system NAVAID failures (may be combined with other maneuvers),

5). **Engine Failures**. Engine failure prior to or during approach (if specific flight characteristics of the aircraft or operational authorizations require this maneuver),

6). **Low Visibility Rollout**. Manual roll out with low visibility at applicable minima (may be combined),

7). **Realistic Environmental Conditions**. Landings (in simulation) with environmental conditions at a representative sample of limiting values authorized for applicable Category I or II minima for that operator (e.g., regarding wind magnitude, headwind and crosswind components, turbulence, and runway surface friction characteristics (wet, snow, slippery - may be combined), and

8). **Non-normal configuration approaches and landings**. Representative non-normal configuration approaches and landings in instrument conditions should be demonstrated. For these approaches, the simulated weather minima may be above, or well above, the lowest Category I or Category II minima authorized. Minima should be at levels that might typically be experienced in line operations, for a landing with the non-normal condition used. During these approaches, representative autoflight, instrument, and aircraft system configurations or combinations of configurations should be demonstrated (e.g., flight director, autopilot, autothrottles, raw data, inoperative electrical or hydraulic components).

9). **Basic Airmanship Skills.** In accomplishing items 1. through 8. above, each pilot should demonstrate competence, or be judged to have the necessary competence in "basic airmanship skills" to adequately address:

a). **Manual Control.** Manual control, or reversion to manual control of the aircraft, if necessary, (for FBW aircraft, normal law or configuration is acceptable)

b). **Automation**. Proper use of automation,

c). **Situation Awareness**. Appropriate planning and situation awareness, including terrain awareness,

d). **Detection and coping with adverse environmental factors**. Ability to detect and cope with adverse environmental conditions (e.g., applicable crosswinds, turbulence, windshear, convective weather, or adverse airport conditions (e.g., slippery runways)),

e). **Detection and coping with adverse NAVAID factors.** Detection Ability to detect and cope with adverse ground system, space system, or NAVAID failures or anomalies), and

f). **Crew coordination and CRM**. Proper crew coordination, and crew resource management.

**g. Flight Training Maneuvers for Takeoffs.** For low visibility takeoff (RVR less than 2400 RVR), the following maneuvers and procedures should be addressed (may be combined):

1). **Normal takeoff**,

2). **Rejected takeoff** from a point prior to V1 (including an engine failure),

3). **Continued takeoff** following failures including engine failure, and any critical failures for the aircraft type which could lead to lateral asymmetry during the takeoff, or

4). **Limiting conditions**. The conditions under which these normal and rejected takeoffs should be demonstrated include appropriate limiting cross winds, winds, gusts and runway surface friction levels authorized. A demonstration should be done at weights or on runways that represent a critical field length.

**h. Demonstration Of Appropriate PF Or PNF Duties By Each Pilot.** During each of the specified maneuvers or procedures, crewmembers are expected to perform their respective assignments or duties (e.g., Captain, First Officer, PIC, SIC, Pilot-Flying (PF), Pilot-Not-Flying (PNF)), as applicable. However, PICs and SICs should typically be able to perform either PF or PNF duties, unless otherwise limited by the operators policies or aircraft characteristics (e.g., if F/Os are precluded by operator policy or system installation (HUD) from serving as PF during certain adverse weather takeoffs or landings). In situations where crewmembers are being qualified other than as part of the complete flightcrew (e.g., when two pilots in command are being qualified) or when a pilot other than the PIC is also to be authorized to serve as the PF for low visibility operations, each crewmember should individually demonstrate the required maneuvers or procedures, or an acceptable sample of procedures. Relevant procedures are those involving manual control of the aircraft, rather than procedures such as autoland, which may not involve significant differences in PF or PNF skills.

**7.2.1. Initial Qualification.** Prior to maneuver or flight training, Initial General Knowledge (Ground) Training for "All Weather Operations (AWO)" should be addressed. Coverage of those subjects specified in 7.1 should typically be completed for each pilot having assigned AWO responsibilities.

Maneuver or Procedure (Flight) Training addressing suitable for that operator's Initial Qualification for "All Weather Operations (AWO)" should be conducted. While the number of procedure types covered, number of simulator periods, number of training flights, if any, or other factors may vary, coverage should at least address the expected initial assignment of the crewmember receiving the initial training. AWO training may be combined with the initial aircraft type qualification training program or it may be done separately as AWO qualification. Regardless, the operator is expected to provide sufficient initial training to assess knowledge and skills of each new crewmember, address any individual area of weakness, assure each crewmember can perform to applicable AQP, PTS, or other relevant standards, and assure that each crewmember can competently perform the maneuvers or procedures specified in 7.2 above.

If weaknesses are identified, it is expected that the operator will provide sufficient remedial training to assure that any new crewmember can perform to applicable FAA Commercial Pilot, Instrument, Multiengine, or ATPC standards, for the applicable aircraft type or variant, and can acceptably use that operator's policies, manuals and procedures, before releasing that crewmember to IOE or to serve in line operations.

When Category I or II minima are based on manual operations using systems like head-up displays or flight directors, a number of repetitions of the maneuvers specified in 7.2 above may be necessary to assure that each of the required maneuvers can be properly and reliably performed.

Operators should also assure that crewmembers receiving initial training have appropriate basic airmanship skills related to AWO (e.g., crosswind takeoff and landing skills, ability to fly to an adequate level using raw data, ability to assess and safely cope with adverse runway friction, make adverse weather avoidance judgments), or are provided relevant remedial training.

Guidance for acceptable programs related to a particular aircraft type can be found in FAA FSB reports for specific aircraft types. Operators should adhere to FSB guidelines when published, unless otherwise authorized by AFS 400. Sufficient assessment should take place to assure that the operator has determined that above objectives have been met for each crewmember, and that the resulting evaluation or assessment can be documented.

**7.2.2. Recurrent Qualification.**

1. Recurrent General Knowledge (Ground) Training for All Weather Operations (AWO). Recurrent General Knowledge (Ground) Training for All Weather Operations (AWO) should provide any remedial review of topics specified in 7.1 to assure continued familiarity with those topics. Emphasis should be place on any program modifications, changes to aircraft equipment or procedures, review of any occurrences or incidents that may be pertinent, and finally emphasis may be placed on re-familiarization with topics such as mode annunciations for failure conditions or other information which the pilots may not routinely see during normal line operations. Topics to be addressed for each pilot in command, second in command or other crewmember, or dispatcher if applicable, are those topics necessary for the performance of the assigned duties for each respective crewmember or dispatcher in the current assignment.

2. Recurrent Maneuver or Procedure (Flight) Training for All Weather Operations (AWO). Recurrent Maneuver or Procedure (Flight) Training for Category I or II landings and low visibility takeoffs, as applicable, should be provided to assure competency in each of the maneuvers or procedures listed in 7.2 above.

Recurrent Maneuver or Procedure (Flight) Training should be conducted using an approved simulator with an appropriate visual system. In the event that simulation is not available, recurrent flight training may be accomplished in the aircraft, as approved by the CHDO/principal operations inspector considering factors identified in Para 7.2 e.

Recurrent flight training should include at least sample applicable Category I or Category II procedures to be used, emphasizing any rare or critical procedures used by that operator which have not otherwise been flown routinely or recently by the crewmember, but which may be needed. Emphasis may be placed on any critical non-normal procedures (e.g., engine inoperative, system failure cases), and any special emphasis procedures or items found to require attention due to in service feedback by the operator (e.g., excessively high descent rates near the surface, proper VNAV use). At least some procedures should be sampled at or near limiting adverse weather conditions (e.g., at minimum RVR or limiting wind components or with windshear, or to runways with minimum operationally used field lengths, or at critical terrain airports or at airports having operator unique special airport procedures). Repetition of maneuvers frequently accomplished successfully in line operations (e.g., normal ILS, normal autoland) may be de-emphasized by limited sampling, and limited assessments or those conditions and procedures.

Recurrent flight training maneuvers may be accomplished individually or may be integrated with other maneuvers required during proficiency training or during proficiency checking. If minima are authorized using several methods of flight guidance and control such as FMS, autopilot, flight director or head-up display, then the training program should assure an appropriate level of proficiency using each authorized mode or system. Where Category I or II minima are based on manual control using flight guidance such as provided by a headup flight guidance system, appropriate emphasis should be placed on failure conditions which a pilot does not normally experience in line operations.

When takeoff minimums below RVR2400 are approved, recurrent flight training must include at least one rejected takeoff at the lowest approved takeoff minima used, with an engine failure near but prior to V1.

Numbers of maneuvers or procedures to be performed during recurrent training or checking should be sufficient to ensure appropriate crewmember performance, but not less than the following:

1) An engine inoperative approach to a landing and a go around.

2) Appropriate aircraft or ground system NAVAID failures.

3) Approaches and landing(s) with environmental conditions at a representative sample of limiting values authorized for applicable Category I or II minima for that operator (e.g., wind components, turbulence, windshear or limiting runways or adverse runway surface friction).

4) Any special emphasis procedures or items identified by the operator or CHDO/POI.

5) A low visibility takeoff with critical performance or a suitable failure condition.

**7.2.3. Qualification in conjunction with Advanced Qualification Programs (AQP).** Appropriate re-qualification or recurrent qualification programs may be adjusted as necessary when incorporated in AQP or other single visit training programs. With such programs, however, each of the areas of knowledge specified by Section 7.1 and each of the areas of competency specified in Section 7.2 must be assured.

**7.2.4. Re-qualification.** Credit for previous Category I or II qualification in a different aircraft type or variant, or previous qualification in the same type or variant at an earlier time may be considered in determining the type of program, length of program, required maneuvers to be completed or the repetition of maneuvers for re-qualification for Category I or II operations. Any re-qualification program should assure that the pilots have the necessary knowledge of the topics specified in Section 7.1, and are able to perform their assigned duties for Category I or II or low visibility takeoff considering the maneuvers or procedures identified in Section 7.2.

For programs which credit previous Category I or II qualification in a different type aircraft, the transition program should assure that any subtle differences between aircraft types which could lead to pilot misunderstanding of appropriate characteristics or procedures in the new type must be suitably addressed.

**7.2.5. Upgrade Qualification.** Credit for previous Category I or II qualification in a different crew position in the same type or variant at an earlier time may be considered in determining the type of program, length of program, required maneuvers to be completed or the repetition of maneuvers for upgrade qualification for an aircraft type authorized for Category I or II operations. Any upgrade program should assure that the pilot has the necessary knowledge of the topics specified in Section 7.1, and are able to perform the new or additional assigned duties for the new crew position for Category I or Category II or low visibility takeoff considering the maneuvers or procedures identified in Section 7.2.

Credit may also be permitted, as determined appropriate by the CMO, for prior pilot experience with a similar flight deck and flight guidance system (e.g., A330 and A340; B757 and B767). (Also see FAA AC120-53).

**7.2.6. Differences Qualification - Addressing Cockpit or Aircraft System Differences.** For Category I and II programs using aircraft which have several variants, training programs should assure that pilots are aware of any differences that exist and appropriately understand the consequences of those differences. Guidelines for addressing differences can be found in FAA AC 120-53 and FSB reports applicable to a particular type.

**7.2.7. Recency of Experience.** Recency of experience requirements specified by section 121.439 or in accordance with AC 120-53 normally provide an assurance of the necessary level of experience for Category I or II landing or low visibility takeoff operations. In the event that special circumstances exist where crewmembers may not have exposure to particular aspects of the flight guidance system used for long periods of time beyond that permitted by section 121.439 or AC 120-53, then the operator should assure that the necessary recency of experience is addressed prior to pilots conducting Category I or II landings, or low visibility takeoff operations below RVR2400.

For FMS/RNAV or RNP approaches or automatic landing systems, pilots should specifically be exposed to use of these systems and procedures during training or checking if the crew has not otherwise conducted frequent relevant similar line operations with those systems since the previous training cycle or event.

For manual flight guidance landing or takeoff systems (e.g., HUD) a pilot flying should typically be afforded an opportunity to use such systems or procedures in the aircraft or in simulation once each 90 days. If the pilot has not otherwise had an opportunity to conduct line approaches or landings using the manual flight guidance system within the previous 90 days, a simulator refresher, recurrent training or checking event, line operational use in weather conditions better than basic VFR, flight with a check airman, or other similar method acceptable to the POI may be used to re-establish recency of experience with that system.

**7.3. Checking or Evaluations.**

**7.3.1. Checking For Category I Qualification.** Testing, checking or evaluation for Category I is basic to qualification for IFR operations, and should be accomplished in conjunction with basic aircraft type or variant qualification for each crew position. Testing or evaluation, if necessary and as necessary, should be keyed to assuring that each pilot has the necessary knowledge and skill appropriate to the type of qualification being completed (e.g., Initial, transition, upgrade, differences, or re-qualification programs) in accordance with applicable regulations (e.g., SFAR 58 Approved AQP program, part 121 appendix F, part 61, and applicable FAA ATPC Type Rating Practical test Standards). (Also see initial, transition, upgrade, or differences sections above.)

**7.3.2. Checking For Category II Qualification.** Specific testing or evaluation should be completed for Category II qualification. Crewmembers should demonstrate proper use of Category II related aircraft systems and correct procedures including any provisions otherwise specified by an applicable FSB report. If not otherwise addressed by Category I or Category III qualification, pilots should demonstrate proficiency in performing duties related to conduct of Category II approaches including at least the following conditions individually, or in any combination:

1) A normal approach to a landing and to a go-around at or near Category II minima,

2) Approaches with related aircraft system, navigation system, or flight guidance failures,

3) An engine-inoperative approach (if authorized for engine-inoperative Category II capability),

4) For initial qualification which includes use of an automatic landing system, at least one automatic landing , and if applicable, one automatic go-around from a low approach (at or after DA(H) but before touchdown). The approach or go-around may be conducted in either normal or non-normal conditions, as determined appropriate by the operator and CHDO,

5) For continuing qualification which includes use of an automatic landing system, at least one automatic landing or low altitude automatic go-around (if applicable), with a relevant non-normal condition,

6) For manual flight guidance and control systems (e.g., HUD) one landing at the lowest applicable minima and one go-around from low altitude below DA(H), and at least one response to a failure condition during the approach or missed approach, and

7) Recognition and proper response to other representative non-normal conditions or adverse weather situations (e.g., Outage NOTAM, NAVAID failure, variable or below minima weather, ILS critical area protection anomaly).

**7.3.3. Combined Checking For Simultaneous Category I/II or I/II/III Qualification.** When qualification programs simultaneously address Category I and Category II, or Category I, II and Category III, testing events may be appropriately combined, and the FAA or operator need not repetitively test each type of approach at each landing Category.

**7.3.4. Checking For Low visibility Takeoff Qualification.** For new low visibility takeoff authorizations, and unless otherwise qualified for low visibility takeoff in accordance with FAA AC 120-28D, before using any takeoff minima below

RVR1200, pilots should have successfully demonstrated in simulation at least one takeoff at the lowest applicable minima with an engine failure at or after V1, and one rejected takeoff with an engine failure or other appropriate failure prior to V1.

If an acceptable simulator is not available, the demonstration may be conducted in the type of aircraft to be authorized for use of takeoff minima below RVR1200. Representative failure speeds and conditions may be used that do not risk or adversely affect the aircraft or its systems (e.g., tires and brake energy). Use of a view limiting device for the pilot being evaluated is not necessary.

**7.4. Experience with Line Landings.** For Category II, unless otherwise specified by an applicable FSB report for the aircraft type, when a qualification program has been completed using a simulator program other than Level C or D, at least the following experience should be required before initiating Category II operations:

1. For automatic systems at least one line landing using the auto flight system approved for Category II minima should be accomplished in weather conditions at or better than Category II.

2. For manual systems such as head-up flight guidance system for Category II, the pilot in command must have completed at least ten line landings using the approved flight guidance system and procedures, in the configuration specified for Category II, at suitable runways and using suitable landing NAVAIDs.

**7.5. Crew Records.** The operator should assure that records suitably identify initial and continued eligibility of pilots for Category I or II operations. Records should note the appropriate completion of training and any necessary checking for both ground qualification, flight qualification, initial qualification, recurrent qualification, differences qualification, upgrade qualification, or re-qualification, or recency of experience for takeoffs or landings, or other tracked events (e.g., AQP), as applicable.

**7.6. Multiple Aircraft Type or Variant Qualification.** In the event that crewmembers are multiply qualified as either captain or first officer, or for performing the duties of the PIC or SIC (e.g., International relief officers), or for crewmembers dual qualified between several aircraft types or variants, appropriate training and qualification must be completed to assure that each crewmember can perform the assigned duties for each crew position and each aircraft type or variant.

For programs involving dual qualification, principal inspectors should approve the particular operators program considering the degree of differences involved in the Category I or II aircraft systems, the assigned duties for each crew position and criteria such as described in FAA AC 120-53 related to differences. If a pilot serving as second in command is not expressly restricted from performing the duties of the pilot in command during Category I or II approaches or low visibility takeoffs below 2400RVR, then that pilot must satisfactorily complete the requirements for a pilot-in-command regarding those low visibility related maneuvers specified in Section 7.2.

**7.7. Interchange.** When aircraft interchange is involved between operators, flight crewmembers must receive sufficient ground and flight training or qualification assessment to assure familiarity and competency with respect to the particular aircraft system or systems of the interchange aircraft. Guidelines for differences should be consistent with those specified in AC 120-53 and any applicable FAA FSB reports.

**7.8. Training Regarding Use of Foreign Airports for Category I or Category II Operations.** Operators authorized to conduct Category I or II operations or low visibility takeoffs below RVR1200 at foreign airports, which require procedures or limitations different than those applicable within the United States, should assure that flight crewmembers, and dispatchers if applicable, are familiar with any meteorological reporting, airport, visual aid, NAVAID, or ATS clearance or procedure differences appropriate to operations at those foreign airports.

**7.9. Initial Operating Experience (IOE)/Supervised Line Flying (SLF).** Any Initial Operating Experience (IOE) or Supervised Line Flying (SLF) conducted by the operator should be consistent with and assure compliance with applicable provisions of the AWO program of the operator.

**7.10. Line Checks, Route Checks, LOE, LOS, or LOFT.** Any "Line Checks", "Route Checks", LOS, LOE, or LOFT (or other equivalent AQP events) conducted by the operator should be consistent with, and assure compliance with applicable provisions of the AWO program of the operator.

**7.11. Special Qualification Requirements for Particular Category I or Category II Operations.** Certain authorizations may require additional Category I or II training or qualification such as specified in paragraph 7.11.1 through 7.11.5 below. Additionally special qualification may be required for particular instrument procedures, particular types of procedures, or particular airports as determined appropriate by the operator or CMO.

**7.11.1. HUD or Autoland.** Use of Certain RVR 1800 Authorizations based on HUD or Autoland. Use of lower than standard Category I minima based on use of HGS guidance or Autoland may be authorized. Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

**7.11.2. Use Of Lowest Category I Minima At Certain Obstacle Limited Or Restricted ILS Facilities.** Operators may receive an authorization to use the lowest Category I minima at runways otherwise restricted to use higher minima due to near-in obstacles (e.g., KDTW RW21R). Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

**7.11.3. Simultaneous Operations using PRM Radar.** For pilot procedures regarding Simultaneous Operations using PRM Radar, see the Aeronautical Information Manual. When these procedures are used by an operator, flightcrews should be suitably briefed on their appropriate use, and how and when to decline their use.

**7.11.4. Simultaneous Operations with Converging Approaches and Coordinated Missed Approaches.** Simultaneous Operations with Converging Approaches should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, how to program the procedure in the FMS, if applicable, how to determine if their aircraft can comply with an applicable missed approach clearance for that particular landing, how to determine if there are any special SIAP or airport procedures to be used, what to do in a contingency, and circumstances in which it may be appropriate to decline such a clearance.

**7.11.5. Simultaneous Runway Operations (LAHSO).** Simultaneous Operations with land and hold short ATS clearances (LAHSO) should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, if their aircraft can comply with a LAHSO clearance for that particular landing, how to determine if there are any special airport markings or lighting to be used, what to do in a contingency if the other aircraft does not respond as expected or cannot stop in the allocated distance, if a failure occurs on either aircraft, or if either or both aircraft must reject the landing, and circumstances in which it may be appropriate to decline such a clearance.

**7.11.6 Special Qualification Airports.** The operator may identify certain airports as requiring special flight crew qualification regarding instrument procedures, in conjunction with FAR 121.445, or in addition to FAR121.445.(e.g., due to unusual terrain, obstructions, or weather).

**7.11.7 Special Qualification Instrument Procedures or Types of Instrument Procedures.** The operator may identify certain instrument procedures or types of procedures as requiring special flight crew qualification (e.g., due to use of particular flight guidance systems or procedures, or requirements for FTE management, or procedure complexity)

**7.12. Special Qualification Requirements for Category II Operations at Certain U.S. Type I ILS Facilities.** Qualification Requirements for Category II Operations at Certain U.S. Type I ILS Facilities requires that flightcrews, and dispatchers if applicable, be familiar with any operational aspects of the applicable OpSpecs for these special operations, the DA(H) and RVR minima to be used, required visibility reports necessary to be used, controlling visibility or RVR to be applied, lighting aids required, and any precautions necessary that may be unique to the airport or Type I ILS facility used.

**7.13. Simultaneous Training and Qualification for Category I and II.** Training and qualification may be completed individually for Category I and II or may be combined.

When combined Category I and Category II training is completed, pilots must clearly be aware of responsibilities for each Category of approach used, including differences in methods for determination of minima, controlling visibility or RVR, use of correct procedures and callouts for each Category, requirements for airborne equipment for initiation of approach with normal configurations, and response to typical failure cases appropriate for each Category of approach.

**7.14. Simultaneous Training and Qualification for Category I, II and III.** See AC 120-28D for provisions addressing Category III.

Training and qualification may be completed individually for Category I or II, or may be combined for Category I, II and III.

When combined Category I/II/III training is completed, pilots must clearly be aware of responsibilities for each Category of approach used, including differences in methods for determination of minima, controlling visibility or RVR, use of correct procedures and callouts for each Category, requirements for airborne equipment for initiation of approach with normal configurations, and response to typical failure cases appropriate for each Category of approach.

**7.15. Credit for "High Limit Captains" (Reference Section 121.652, 125.379, 135.225).** When authorized by the POI, credit for high landing weather minimum limits and required turbojet experience may be authorized consistent with provisions of exemptions authorized for Category I or II qualification credit. Among other provisions of the FAA exemptions, crews eligible for this credit must meet applicable provisions of Sections 7.1 and 7.2 above.

**7.16. Particular Approach System/Procedure Qualification.**

**7.16.1. Autoland Qualification.** Unless otherwise specified by FAA in OpSpecs, autoland qualification for Category I or II may be completed through use of Level A, B, C or D simulation, or by observation of an autoland during IOE. When using simulation, at least one normal autoland and one autoland with a failure or non-normal condition requiring pilot intervention or takeover should be completed.

**7.16.2. Head Up Display Qualification.**

**a. Category I or II, or Category I and II.** An acceptable list of flight training events for Category I, or Category II, or Category I and II qualification is shown below.

For qualification, the PF (usually the Captain) and PNF (usually the F/O) should each accomplish their respective duties. It is desirable but not required that the PNF receive at least some exposure to use of the HUD as PF, in order to be familiar with its operation, its characteristics, and its limitations.

Takeoffs:

Two Takeoffs (RVR at lowest authorized minima - e.g., RVR300),

One with an engine failure leading to continuation,

One with any failure leading to an RTO,

One windshear event during takeoff.

Landings:

Five for the lowest Category I or Category II qualification as applicable (three with, two without failures),

Five Missed Approaches/balked landings due to a failure,

One Circling approach (non ILS/GLS/MLS).

**b. Simultaneous Category I/II/III qualification (also see AC120-28D).** An acceptable list of flight training events for Simultaneous Category I/II/III qualification is shown below.

The PF / PNF should each accomplish respective duties as in a. above. In addition, it is appropriate that the PNF receive at least limited exposure to use of the HUD as PF. The number of events for the PNF, however, may be determined by the operator considering the experience and familiarity of the PNF with HUD operations.

Landings:

Two Category I (one with, one without failure),

One Category II (with or without a failure),

Five Category III (three with, two without failures),

Five Missed Approaches/balked landings due to a failure,

One Circling approach (non ILS/GLS/MLS), if applicable for that operator.

**7.16.3. RNAV Approach Qualification.** Requirements to conduct RNAV approaches (e.g., for /E or /F qualified airplanes, or RNP qualified aircraft) that already routinely use LNAV/VNAV autoflight modes, are as follows:

1) The flightcrew must know how to properly use the applicable navigation system(s) for the particular types of approaches to be flown. This is typically addressed in training as a crewmember initially qualifies to fly a particular type or variant.

2) The flightcrew should have, know, or be able to do each of the items below.

a. Have access to the appropriate instrument chart(s) (e.g., SID, STAR, or approach plates) for the applicable procedures,

b. Know how to properly load the procedure(s) and any associated transitions, string related waypoints, address discontinuities, enter associated data (e.g., path constraints, altitude constraints, speed constraints, winds, anti-ice initiation altitudes), and

c. Know how to properly fly the procedure(s) (e.g., operate the aircraft to properly stay on the designated LNAV and VNAV path, and meet constraints, regardless of autoflight mode(s) selected for use, or unexpected mode changes or reversions).

3) The flightcrew must know how to properly apply applicable flight information (e.g., NOTAMs), if any, for the navigation system and route of flight (e.g., to properly deselect relevant NAVAIDs that are out of service, or could otherwise cause a problem such as a map shift, if they could adversely and significantly degrade nav system performance),

4) The flightcrew must know how to apply or accomplish any routine or special flight deck procedures specified by the operator for the approach type used or for the particular approach to be flown, including:

a. Tuning or setting associated radios, altimeters, radar altimeters,

b. Setting reference bugs and MCP altitudes, speeds, or headings,

c. Selecting or arming appropriate AFDS modes,

d. Performing any necessary navigation performance/map validity verification checks, using some acceptable method to the operator, to assure suitable navigation performance. Examples of acceptable verification methods typically include:

1. A crosscheck of FMS position with raw data prior to passing a FAF or FAP,

2. A crew assuring that the FMS is using an acceptable updating mode during the descent check (e.g., DD IRS (3)), and no map shift is evident prior to passing the FAF or FAP,

3. Periodically monitoring raw data nav information for consistency with RNAV position information that is displayed on the PFD or ND, or

4. Comparison of RNAV position or other parameters (e.g., radio altitude at a known waypoint or position) with other independent sources of acceptable position information (e.g., Crosscheck an LNAV path with a path depicted by radar or EGPWS, if applicable) which assures the validity of the navigation system position estimate. Crosschecking VNAV with radio altitude, if applicable.

5. Know how to verify navigation data base loads for currency, verify waypoint and critical waypoint validity, if applicable. Know how to verify appropriate levels of RNP, ANP, EPE, as applicable. Know how to verify suitable sensor performance if applicable (e.g., Acceptable IRS drift rate performance, DME-DME, VOR-DME or GPS updating)

e. Configuring the aircraft at appropriate times, or in conjunction with ATS clearances (speed intervention adjustments), and addressing or otherwise appropriately responding to related aircraft or system status annunciations, advisories, alerts, cautions or warnings.

5) The flightcrew must be familiar with any unique issues particular to a specific approach or family of approach procedures (e.g., proper use of RNP [if applicable] for each particular approach or missed approach segment, or any special flight guidance procedures or actions necessary to accomplish the procedure(s) such as with the flight director, autopilot, autothrottle, or FMS).

6) The operator must have the pertinent OpSpecs paragraph and the flightcrew must be aware of any operationally significant OpSpec provisions that relate to the procedures to be flown.

The above provisions may be addressed through initial or revised FCOM material, briefing bulletins, demonstrations, having crews accomplish typical procedures during scheduled PC/PT or AQP events, or as briefing emphasis items during IOE.

Each operator should assure that effective methods are used to implement applicable RNAV or RNAV/RNP procedures to assure that in line operations each pilot can perform assigned duties reliably, and expeditiously for each procedure to be flown, both in normal circumstances, and for probably non-normal circumstances (e.g., engine failure and other representative QRH, or equivalent, non-normals).

The best method or method(s) to be used by a particular operator to assure competency in flying RNAV or RNAV/RNP procedures may vary significantly from operator to operator. Methods, level and extent of training and checking, and recency may depending on the type of procedures used by the operator, the aircraft/FMS types and any autoflight systems used, level of familiarity or experience of crews with the FMS, autoflight, and the RNAV or RNAV/RNP procedures used, the complexity and criticality of procedures to be flown, and the environment in which the procedures are flown.

The CHDO (assigned POI/APM) may determine any credit allowed for an operator, or additional constraints determined necessary for that operator based on the above factors, and considering any provisions described in the applicable FSB report for the type.

**7.16.4. Category I or II Operations with an Engine Inoperative.**

**Category I.** For a Category I approach with inoperative engine(s), appropriate training should be completed to assure that pilots, and dispatchers if applicable, can properly identify and select the nearest adequate or suitable airport (2 engine aircraft),

or a safe airport (3 or more engine aircraft) pertinent to OpSpecs and Federal Aviation Regulations, to safely conduct an engine(s) inoperative landing. The flightcrews, and dispatchers if applicable, should have and demonstrate knowledge of factors influencing selection of a suitable airport for landing and safe completion of the approach considering factors such as the following:

1) Engine(or engines) inoperative aircraft configuration (e.g., degree of thrust asymmetry, appropriate flap settings, adjusted reference speeds, remaining reverse thrust capability and use),

2) Other potentially affected aircraft systems (e.g., electrical, or hydraulic),

3) Weather Conditions (winds, turbulence, ceiling and visibility, RVR, icing, windshear, crosswind or tailwind components, recency and accuracy of weather information),

4) Use of appropriate minima for the configuration and possible need for adjustment of approach and landing minima to suit the particular circumstances,

5) Special minima considerations that might be appropriate (e.g., engine-out missed approach obstacle or terrain assurance and balked landing obstacle avoidance considerations, consideration of subsequent engine failure (aircraft with more than 2 engines),

6) Selection of most favorable NAVAIDs, runway, or runway conditions (e.g., regarding braking friction, clutter),

7) Availability of emergency services,

8) Airport and procedure familiarity,

9) Nearby terrain or obstruction considerations,

10) MEL status, and

11) Pilot recency of experience.

Operators should at least be familiar with, and provide the necessary training to flightcrews, and dispatchers if applicable, to address the above factors or issues considering that an engine failure may occur during or after takeoff, while en route, prior to approach, after passing the final approach fix, at or below MDA(H) or DA(H) leading to either a landing or go-around, or during missed approach.

**Category II.** For Category II the factors listed above for training and qualification for Category I should be considered, and in addition the following should be addressed. For crews authorized to initiate a Category II approach with an inoperative engine either through Category II flight planning or dispatch procedures or for engine failures which occur en route, appropriate training should be completed to assure that crews can properly apply the provisions of Sections 5.17.1 or 5.17.2. For airlines that do not authorize the initiation of a Category II approach with an engine inoperative as an approved procedure, crews should at least be familiar with the provisions above for Category I and provisions of Section 5.17.3,5.17.4, and 5.17.5 regarding an engine failure after passing the final approach fix.

**7.16.5. Enhanced Vision Systems (EVS), Synthetic Vision Systems (SVS), or Independent Landing Monitor(ILM).** Training required for enhanced vision systems or synthetic vision systems, or independent landing monitor may be specified by FAA based on successful completion of proof of concept testing, as applicable. Pertinent requirements are as specified in the applicable FSB report.

**8. AIRPORTS, NAVIGATION FACILITIES AND METEROLOGICAL CRITERIA.** United States and non-United States airports and runways authorizable for Category I and II are those either having published part 97 SIAPS, or as

otherwise specified on the FAA AFS-400 "Category II status checklist" (FAA Order 8400.8). Requests for authorization to use other airports/runways should be coordinated with AFS-400, through the operator's CHDO.

**8.1. Use of Standard Navigation Facilities.** United States Category I approaches may be approved as published by part 97 SIAPS or as special procedures in OpSpecs

Category II operations may be approved on standard United States or ICAO navigation facilities as follows:

United States ILS facilities for which part 97 Category II procedures are published,

Other United States ILS facilities determined acceptable by AFS-400 for the type of aircraft equipment and minima sought,

Non-United States facilities meeting ICAO criteria (ICAO Annex 10, ICAO Manual of All Weather Operations DOC 9365/AN910, etc.) and which are promulgated for use for Category II by the "State of the Aerodrome", and

Category II operations require facilities assessed and classified at least through point D (e.g., II/T/2).

**8.2. Use of Other Navigation Facilities or Methods.** Category I or II operations may be approved using other types of navigation facilities or using other acceptable position fixing and integrity assurance methods, if proof of concept demonstrations acceptable to FAA are successfully completed:

Other United States facilities approvable for Category I and II (MLS, DGPS, or ILS used in conjunction with an acceptable aircraft integrity assurance system, etc.) are as determined acceptable by AFS-400, and

Non-United States ILS facilities meeting acceptable criteria other than ICAO (e.g., JAA), may be used as determined to be acceptable by AFS-400.

Operations may be approved using other types of navigation facilities or using other acceptable position fixing and integrity assurance methods, if proof of concept demonstrations acceptable to FAA are successfully completed:

Other United States facilities approvable for Category II (e.g., MLS, DGPS, Type I ILS used in conjunction with an acceptable aircraft integrity assurance system) are as determined acceptable by AFS-400, and

Non-United States ILS facilities meeting acceptable criteria other than ICAO (e.g., JAA), may be used as determined to be acceptable by AFS-400.

**8.3. Lighting Systems.** Lighting for Category I is as specified by Standard OpSpecs, part 97 SIAPS, or any special provisions or procedures identified in OpSpecs.

Lighting used for Category II must include the following systems, or ICAO equivalent systems, unless approved by AFS-400 (e.g., special provisions for Non-United States airports) or specific aircraft systems such as HUD or autoland:

United States Standard ALSF 1 or ALSF 2 approach lights,

United States Standard Touchdown Zone Lights,

United States Standard Runway Centerline Lights, and

United States Standard High Intensity Runway Lights.

Exceptions to the above lighting criteria may be authorized only if equivalent safety can be demonstrated by an alternate means (e.g., substitution for required approach lighting components due to use of an approved aircraft system providing equivalent information or performance, such as use of an autoland system, head up display (HUD) with inertially augmented flight path vector display), or availability of redundant, high integrity, computed or sensor based (e.g., high resolution radar) runway information, suitably displayed to a pilot.

**8.4. Marking and Signs.** Marking and signs for Category I are as specified by the FAA for precision approach runways, except as otherwise authorized by AFS-400.

Airports approved for Category II must include the following runway and taxiway markings and airport surface signs, or ICAO equivalent, unless approved by AFS-400 (e.g., for Non-United States airports):

United States Standard Precision Instrument Runway Markings,

United States Standard Taxiway edge and centerline Markings, and

Runway signs, taxiway signs, hold line signs, taxiway reference point markings (if required by SMGC), and NAVAID (ILS) critical area signs and markings.

For Category II, markings and signs must be in serviceable condition, as determined by the operator or FAA CHDO. Markings or signs found in an unacceptable condition by an operator should be reported to the appropriate airport authority and CHDO. Operators should discontinue Category II use of those areas of airport facilities or runways where unsafe conditions are known to exist due to markings or signs being inadequate, until remedial actions are taken by the airport authority (e.g., snow removal, rubber deposit removal on runway touchdown zone markings or centerline markings, critical area hold line or runway centerline marking repainting, runway hold line sign snow removal).

**8.5. Low Visibility Surface Movement Guidance and Control (SMGC) Plans.** Surface movement guidance and control plans are recommended for operations below Category I. Where such plans are used, operators intending authorization for Category II should coordinate with the airport authority regarding the use of a SMGC plan prior to OpSpec authorization for that airport. Equivalent coordination should also be completed at non-United States airports if such a plan is used by that airport.

United States airports conducting takeoff or landing operations below 1,200 feet RVR are required to develop a Surface Movement Guidance and Control System (SMGCS) plan. SMGCS operations facilitate low visibility takeoffs and landings and surface traffic movement by providing procedures and visual aids for taxiing aircraft between the runway(s) and apron(s). Specific low visibility taxi routes are provided on a separate SMGCS airport chart. SMGCS operations also facilitate the safety of vehicle movements that directly support aircraft operations such as aircraft rescue and fire fighting (ARFF) and follow-me services, towing and marshaling.

AC 120-57 describes the standards and provides guidance in implementing SMGCS operations such as aircrew training, etc. An operator intending authorization for Category III operations should coordinate with the airport authority regarding their SMGCS plan. Equivalent coordination is also applicable at non-U.S. airports if such a plan is used by that airport.

For low visibility operations requiring a SMGC plan, separation of at least 500 ft should typically exist between the centerline of any runway to be used and the centerline of any adjacent taxi way. When this runway to taxiway distance is less than 500 ft, an on-site evaluation based on a case by case basis may be appropriate to establish SMGC procedures.

**8.6. Meteorological Services and RVR availability requirements.** Standard meteorological reporting required by part 121 and 135 is acceptable for Category I.

For Category II, appropriate meteorological service (e.g., SA, FT, RS, RVR, RVV, METAR, METAF, Braking Action, NOTAM, etc., reports, as applicable) are necessary for each airport/runway intended for use by an operator for Category II, unless otherwise approved by AFS-400. Non-United States facilities should meet criteria of ICAO Doc 9365/AN910, second edition, or later, as amended.

For Category II, TDZ, MID, and ROLLOUT RVR (or a corresponding international equivalent) should be provided for any runway over 8000 ft in length. TDZ and ROLLOUT RVR should be provided for runways less than 8000 ft. Exceptions to this requirement for United States operators at United States or international locations may be approved on a case by case basis, by AFS-400, if equivalent safety can be established. Factors considered due to local circumstances may include such

issues as minima requested, landing field length requested, characteristics of prevailing local weather conditions, location of RVR sites or RVR calibration, availability of other supporting weather reports on nearby runways, etc.

Aircraft requiring a landing or takeoff distance in normal operation (using operational braking techniques) less that 4000 ft may be approved to use a single TDZ, MID, or ROLLOUT RVR report as applicable to the part of the runway used. For such operations, RVR values not used are optional and advisory, unless the aircraft operation is planned to take place on the part of the runway where a MID or ROLLOUT RVR is located.

In general the controlling RVR for Takeoff, Landing and Rollout are as follows:

i. Take-off:

Where visibility minima are applicable, visibility must be reported sufficiently close to the takeoff runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by FAA, may be determined by the operator or CHDO. Where RVR minima are applicable, RVR must be reported, and the RVR minimum value is considered to be controlling at each relevant RVR reporting point. The RVR/Visibility representative of the initial part of the take-off may be replaced by pilot assessment. For take-off operations the relevant RVR refers to any portion of the runway that is needed for takeoff roll, including that part of the runway that may be needed for a rejected take-off.

ii. Landing:

a. Where visibility minima are applicable, visibility must be reported sufficiently close to the landing runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by FAA, may be determined by the operator or CHDO. Where RVR is used, the controlling RVR for all Category I operations is the touchdown RVR. All other readings, if any, are advisory.

b. The controlling RVR for Category II (for Category III see AC 120-28D) is TDZ RVR or equivalent. Mid and rollout RVR are advisory, unless otherwise specified in OpSpecs.

An acceptable alternate set of OpSpecs may also provide for the following provisions, if determined appropriate by FAA, and agreed by the operator:

1) For airplanes without a rollout guidance or control system TDZ, MID, and ROLLOUT may be specified as controlling. If relevant, the minimum value for the MID may be 400-feet (125-meters) or the value of the touchdown RVR minima, whichever is lower. The value for ROLLOUT RVR, if relevant, may not be less than 250-feet (75-meters). For landing operations the relevant RVR refers to the portion of the runway that is needed for landing down to a safe taxi speed (typically below 60-knots for a large turbojet aircraft).

2) The controlling RVR for Category II operations using airplanes with a rollout or guidance control system is the TDZ RVR, all other readings are advisory.

c. "Inoperative RVR" requirements for dispatch or continuation of a particular flight operations are as specified in standard operation specifications Part C, or any special operations specification provision unique to a particular operator. Unless otherwise approved, in special OpSpecs provisions, the controlling RVR must be operating for all operations based on RVR minima.

**8.6.1. Meteorological Services.** Appropriate meteorological service (SA, FT, RS, RVR, RVV, METAR, METAF, Braking Action, NOTAM, etc., reports, as applicable) are necessary for each airport / runway intended for use. Non-U.S. facilities should meet criteria of ICAO Doc 9365/AN910, second edition, or later, as amended.

**8.6.2. RVR Availability and Use Requirements.**

**8.6.2.1. RVR Availability.** RVR availability requirements for touchdown zone (TDZ), mid runway (MID), and ROLLOUT RVR (or a corresponding international equivalent location) are as follows. RVR should be provided for any runway over

8000 ft in length. TDZ and ROLLOUT RVR should be provided for runways less than 8000 ft. Exceptions to this requirement for United States operators at international locations may be approved on a case by case basis, by AFS-400, if equivalent safety can be established. Factors considered due to local circumstances at non-United States airports may include such issues as: minima requested, characteristics of prevailing local weather conditions, location of RVR sites or RVR calibration, availability of other supporting weather reports on nearby runways, etc.

**8.6.2.2. RVR Use.** RVR use by operators and pilots (controlling and advisory RVR reports) is as specified in standard OpSpecs Part C (see Appendix 7). Since RVR reports can be influenced by runway light step settings, operators should be familiar with and pilots should be familiar with and appropriately request adjustments to light step settings if necessary, to assure best visual reference and to appropriately affect RVR reported values.

**8.6.2.3. Alternate RVR Requirements For Short Field Length Operations.** When approved as an exception in OpSpecs, aircraft capable of certificated landing or takeoff distance of less than 4000 ft may be approved to use a single TDZ, MID, or ROLLOUT transmissometer as applicable to the part of the runway used. For such operations, transmissometers not used are considered to be optional and advisory, unless the aircraft operation is planned to take place on the part of the runway where the MID or ROLLOUT transmissometer is located.

**8.6.2.4. International RVR Reporting and Use Equivalence Considerations.** For RVR reporting and use outside of the US, where international transmissometer locations may be specified by terms or locations other than TDZ, MID, or ROLLOUT as is done in the US (e.g., International transmissometer locations A, B, C, D or 1, 2, 3, 4), the operator may appropriately equate international transmissometer locations and reports to equivalent US transmissometer positions and reports for the purpose of applying Operations-Specification provisions. this applies to transmissometers installed, available, reports, or controlling minima determinations. Unless specifically precluded from doing so by the State of the Aerodrome, Airport Authority, or FAA, where the number of transmissometers available on a runway is different internationally than typically is available in the US (e.g., 4 RVR locations on a runway internationally versus 3 in the US), the operator may determine equivalent suitability of RVR availability, reporting, or minima controlling locations. The operator may correspondingly specify suitable equivalent RVR provisions for flight crew use. When making such a determination the operator should consider the applicable portions of the runway used by the aircraft type(s) in question for touchdown and landing rollout. For takeoff, the operator should consider portions of the runway used both for a continued takeoff and for a rejected takeoff. The operator may also specify acceptable RVR substitutions that may be made for inoperative transmissometers or missing reports. However, for any such determinations, RVR coverage and reporting should be available that is at least equivalent to that which would be otherwise be permitted at authorized US airports.

**8.6.3. Pilot Assessment of Takeoff Visibility Equivalent to RVR.** In special circumstances, provisions may be made for pilot assessment of takeoff visibility equivalent to RVR to determine compliance with takeoff minima. Provisions to authorize pilot assessed RVR is provided through Standard Operations Specifications. A pilot may assess visibility at the take off position in lieu of reported TDZ RVR (or equivalent) in accordance with the requirements detailed below:

1) TDZ RVR is inoperative, or is not reported (e.g., TDZ RVR inop, ATS facility is closed), or

2) Local visibility conditions as determined by the pilot indicate that a significantly different visibility exists than the reported RVR (e.g., patchy fog, blowing snow, RVR believed to be inoperative or inaccurate), and

3) Pertinent markings, lighting, and electronic aids are clearly visible and in service (e.g., no obscuring clutter), and

4) The assessment is made using an accepted method regarding identification of an appropriate number of centerline lights, or markings, of known spacing visible to the pilot when viewed from the flight deck when the aircraft is at the take-off point, and

5) Pilot assessment of visibility as a substitute for TDZ (takeoff) RVR is approved for the operator, and observed visibility is determined to be greater than the equivalent of 300 RVR (90m), and

6) A suitable report of the pilot's determination of visibility is forwarded to ATS or to the operator, as applicable (e.g., if an ATS facility is available and providing ATS services, or if the operator elects to receive such reports).

NOTE: A suitable report of a pilot's determination of visibility provided to ATS or to the operator is intended to facilitate other operations and timely distribution of meteorological information. It is not intended to be a verification of minima or limit or restrict minima for the aircraft making the report.

**8.7. Critical Area Protection.** Airports and runways used for Category I and II must have suitable NAVAID (e.g., ILS) critical area protection, as applicable to the ground and aircraft systems used. Procedures equivalent or more stringent than those specified in the United States AIM (FAA Order 7110.65) as amended, are required. Procedures consistent with ICAO DOC 9365/AN910 are acceptable for non-United States facilities. Where uncertainty regarding acceptability of non-United States airport procedures is a factor, operators or CHDOs should contact AFS-400 (e.g., for non United States airports and runways listed on the FAA Category II status checklist where doubt exists regarding adequacy of procedures encountered in routine operations) for follow up.

**8.8. Operational Facilities, Outages, Airport Construction, and NOTAMs.** For operations to be initially authorized, operations to continue to be authorized, an aircraft to be dispatched with the intention of using a facility described above, or an aircraft to continue to its destination or an alternate with the intent of completing a Category I and II instrument approach procedure, operators must consider the status of components identified in 8.1 through 8.7 above as necessary for Category I or II (NAVAIDs, standby power, lighting systems, etc.) and take appropriate action for inoperative components. The following guidelines are considered acceptable unless otherwise precluded in OpSpecs:

Outer, Middle, or Inner Marker beacons may be inoperative unless a Category I or II operation is predicated on their use (e.g., a DH is predicated on use of an Inner Marker due to irregular terrain, the aircraft system requires use of a marker beacon for proper function).

Lighting systems are in normal status except that isolated lights of an approach light, or runway light system may be inoperative; approach light components not necessary for the particular operation such as REIL, VASI, RAIL, etc. may be inoperative; lights may not be completely obscured by snow or other such contaminants if necessary for the operation (e.g., night).

Operations may be continued at airports at which construction projects affect runways, taxiways, signs, markings, lighting, or ramp areas only if the operator has determined that low visibility operations may be safely conducted with the altered or temporary facilities that are provided. In the event of uncertainty as to the suitability of facilities, the operator should consult with their CHDO.

NOTAMs for NAVAIDs, facilities, lighting, marking, or other capabilities must be appropriately considered for both dispatch, and for continued flight operations intending to use a Category I or II procedures. Operators and flightcrews must appropriately respond to NOTAMs potentially adversely affecting the aircraft system operation, or the availability or suitability of Category I or II procedures at the airport of landing, or any alternate airport intended for Category I and II.

An operator may make the determination that a NOTAM does not apply to the aircraft system and procedures being used for a particular flight if the safety of the operation can be assured, considering the NOTAM and situation.

**8.9. Use of Military Facilities.** Military facilities may be used for Category I and II if authorized by DOD, and if equivalent criteria are met as applicable to United States civil airports.

**8.10. Special Provisions for Facilities Used for ETOPS or EROPS Alternates.** In addition to criteria specified above, an airport used as an ETOPS or EROPS Category II engine-out alternate should meet the following criteria:

Sufficient information about pre-threshold terrain, missed approach path terrain, and obstructions must be available so that an operator can assure that a safe Category II landing can be completed, and that an engine-out missed approach can be completed from the specified DH.

Sufficient meteorological and facility status information must be available so that a diverting flightcrew, and dispatcher if applicable, can receive timely status updates on facility capability, weather/RVR, wind components, and braking action reports (if applicable), if conditions could or would adversely affect a planned Category II landing during the period of an ETOPS or EROPS diversion.

For any alternate airports not routinely used in normal operations by that operator's flightcrews (e.g., Keflavik, Iceland - BIKF), sufficient information should be provided for flightcrews, or dispatchers if applicable, to be familiar with relevant low

visibility and adverse weather characteristics of that airport that might have relevance to an engine-out diversion operation (e.g., unique lighting or markings, any nearby obstructions or frequently encountered local windshear or turbulence characteristics, meteorological report, braking report, and NOTAM interpretation, appropriate ground taxi route and gate location information, emergency services available)

**8.11. Alternate Minima.** Use of alternate minima are specified in Standard OpSpecs Part C paragraph C055. For applicability of "engine inoperative Category II" capability see section 10.8.

Paragraph C055 is issued to all part 121 and part 135 operators who conduct IFR operations with airplanes. This paragraph provides a three-part table from which the operator, during the initial dispatch or flight release planning segment of a flight, derives alternate airport IFR weather minimums in those cases where it has been determined that an alternate airport is required.

A. The first part of the table is for airports with at least one operational navigational facility providing a straight-in non precision approach procedure, or a straight-in precision approach procedure, or, when applicable, a circling maneuver from an instrument approach procedure. The required ceiling and visibility is obtained by adding 400 feet to the Category I HAT or, when applicable, the authorized HAA and by adding 1 sm to the authorized Category I landing minimum, etc.

B. Special provisions for Category II and Category III engine-out capability are listed in the third part of the table for airports with at least two operational navigational facilities, each providing a straight-in precision approach, including a precision approach procedure to Category II DA(H) or Category III. The required ceiling and visibility is obtained by adding 200 feet to the respective lowest Category II or Category III touchdown zone elevation of the two approaches used and by adding RVR1200 to the lowest authorized minimum (see figure below).

**8.12. Dispatch to Airports That are Below Landing Minima.** In certain instances an operator may dispatch an aircraft to a destination airport even though current weather is reported to be below, or may be forecast to be below landing minima. This is to permit aircraft to begin a flight if there is a reasonable expectation that at or near the expected time of arrival at the destination airport, weather conditions are expected to permit a landing at or above landing minima.

Dispatch to such airports typically is considered acceptable if the following conditions are met:

1) All requirements are met to use the landing minimum at the destination airport and at each alternate airport on which the dispatch is predicated (e.g., aircraft, crew, airport facilities, NAVAIDs).

2) If Alternate minima credit is applied based on availability of Category II capability, or Engine inoperative Category II capability, then each of the airborne systems otherwise applicable to use of that capability must be available at the time of dispatch (e.g. flight guidance system, thrust reverse capability, as applicable to the aircraft type and Category II authorization for that operator)

3) ETA at the destination airport considers any necessary holding fuel that may be required while the aircraft waits for weather improvement.

4) Air Traffic conditions are considered for potential delay due to other aircraft arrivals or departures at the destination airport and at each alternate airport.

5) At least two qualifying alternates are available, the first of which considers the aircraft flying to the below minima intended destination, then holding for a time as determined by the operator awaiting approach or weather improvement, then flying to the closest alternate, then completing an approach and missed approach at that airport, and then flying to the second alternate and landing with appropriate reserve fuel.

**8.13 Temperatures and Temperature Extremes**

The operator should address appropriate flight crew and dispatch (if applicable) use of temperature in degrees C, degrees F, and conversion between C and F, if necessary. The operator should address appropriate dispatch (if

applicable) use of temperature in tenths of degrees C or F, and any appropriate rounding or identification of acceptable temperature ranges or bounds, as needed.

The operator should address appropriate flight crew and dispatch (if applicable) use of procedures to compensate for extremely cold temperatures, if necessary [e.g., below -22F/-30C - See also sections 4.3.1.1 item 7), 4.3.4. c., 6.2.13, and 7.1.3. items 4 and 8].

The operator should address appropriate flight crew and dispatch procedures (if applicable) for use of temperatures near or possibly beyond the AFM range, if operations are necessary or are reasonably expected to be conducted at or near AFM limits (e.g., runway temperatures near or above 120 degrees F or near or below -54 degrees F).

**8.14 Pressures and Unusually High or Low Pressures**
The operator should address appropriate flight crew and dispatch procedures (if applicable) for identification of and appropriate setting and use of QNH, QNE, and QFE (if used). This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings as used by that operator (e.g., hectopascals (HPa), millibars (MB), or inches (in)). Emphasis should be placed on assuring use of proper settings for easily confused values for altimeter settings, particularly when abbreviated settings are used in ATS radiotelephony, ATIS messages, or checklists (e.g. "altimeter 993" being mistakenly confused for 29.93 inches instead of 0993 HPa when the appropriate units are metric).

The operator should address any appropriate flight crew and dispatch procedures (if applicable) for unusually Low pressures if necessary for safe operations (e.g., unusable altitudes or flight levels of instrument procedures).

The operator should address appropriate flight crew and dispatch procedures (if applicable) for use of transition Level and transition altitude.

If applicable, the operator should address appropriate flight crew and dispatch procedures or limitations, as necessary, for use of VNAV in states using QFE for approach.

## 9. CONTINUING AIRWORTHINESS / MAINTENANCE.

**9.1 Maintenance Program General Provisions.** Unless otherwise approved by FAA, each operator should have an approved continuous airworthiness maintenance program (CAMP). The approved continuous airworthiness maintenance program should typically include any necessary provisions to address lower landing minima (LLM) or low visibility takeoff in accordance with the operator's intended operation and the manufacturers recommended maintenance program, MRB requirements or equivalent requirements, or any subsequent FAA designated requirements (e.g., ADs, mandatory service bulletins). Emphasis should be on maintaining and ensuring total system performance, accuracy, availability, reliability, and integrity for the intended operations.

**9.2 Maintenance Program Requirements.** The maintenance program should be compatible with an operator's organization and ability to implement and supervise the program. Maintenance personnel should be familiar with the operators approved program, their individual responsibilities in accomplishing that program, and availability of any resources within or outside of the maintenance organization that may be necessary to assure program effectiveness (e.g., getting applicable information related to the manufacturer's recommended maintenance program, getting information referenced in this AC such as service bulletin information).

Provision for low visibility operations may be addressed as a specific program or may be integrated with the general maintenance program.

Regardless whether the maintenance program is integrated or is designated as a specific program for Lower Landing Minima (LLM), the maintenance program should at least address the following:

1) Maintenance procedures necessary to ensure continued airworthiness relative to low visibility operations.

2) A procedure to revise and update the maintenance program.

3) A method to identify, record or designate personnel currently assigned responsibility in managing the program, performing the program, maintaining the program, or performing quality assurance for the program. This includes identification of any contractor or sub-contractor organizations, or where applicable, their personnel.

4) Verification should be made of the lower landing minima systems and configuration status for each aircraft brought into the maintenance or lower minimum program. Unless otherwise accepted by FAA, each aircraft should meet relevant criteria specified by the applicable aircraft manufacturer or avionics manufacturer for associated systems and equipment (e.g., Valid U.S. TC, appropriate STC records and compliance, assessment of status of any engineering orders, ADs, service bulletins or other compliance).

5) Identification of modifications, additions, and changes which were made to qualify aircraft systems for the intended operation or minima, if other than as specified in the AFM, TC or STC.

6) Identification of additional maintenance requirements and log entries necessary to change minima status.

7) Any discrepancy reporting procedures that may be unique to the low visibility program. If applicable, such procedures should be compatibly described in maintenance documents and operations documents.

8) Procedures that identify, monitor and report lower minimum system and component discrepancies for the purpose of quality control and analysis.

9) Procedures that define, monitor and report chronic and repetitive discrepancies.

10) Procedures that ensure aircraft remain out of lower minimum status until successful corrective action has been verified for chronic and repetitive discrepancies.

11) Procedures that ensure the aircraft system status is placarded properly and clearly documented in the aircraft log book, in coordination with maintenance control, engineering, flight operations, and dispatch, or equivalent.

12) Procedures to ensure the downgrade of an aircraft low visibility capability status, if applicable, when maintenance has been performed by persons other than those trained, qualified, or authorized to use or approve procedures related to low visibility operations.

13) Procedures for periodic maintenance of systems ground check, and systems flight check, as applicable. For example, following a heavy maintenance, suitable checks may need to be performed prior to return to service.

14) Provisions for an aircraft to remain in a specific low visibility capability status (e.g., Category II, Fail-Operational, Fail Passive) or other designated operational status used by the operator.

15) Provision should be made for periodic operational sampling of suitable performance. Typically, at least one satisfactory approach should have been accomplished within a specified period approved for that operator, unless a satisfactory systems ground check has been accomplished. A recording procedure for both satisfactory and unsatisfactory results should be included. Fleet sampling is not typically acceptable in lieu of specific aircraft assessment. Typically at least one satisfactory low visibility system operational use, or a satisfactory systems ground check, should be accomplished within 6 months, or within a period as specified by the aircraft or avionics manufacturer for an aircraft to remain in Category II status.

NOTE: Maintenance programs meeting requirements for and approved for Category III typically also are considered acceptable for Category II. Aircraft low visibility systems status, however must be clearly identified for pilots, maintenance, and dispatch, when combined programs are used.

**9.3 Initial And Recurrent Maintenance Training.** Operator and contract maintenance personnel including mechanics, maintenance controllers, avionics technicians, personnel performing maintenance inspection or quality assurance, or other engineering personnel if applicable, should receive initial and recurrent training as necessary for an effective program. The training curriculum should include specific aircraft systems and operator policies and procedures applicable to low visibility operations. Recurrent training should typically be accomplished at least annually, or when a person has not been involved in the maintenance of the specified aircraft or systems for an extended period (e.g., greater than 6 months). Training may lead to a certification or qualification (e.g., for lower landing minima "LLM") if the operator so designates such qualification in that operator's approved program.

The training should at least include, as applicable:

1) An initial and recurrent training program for appropriate operator and contract personnel. Personnel considered to be included are maintenance personnel, quality and reliability groups, maintenance control, and incoming inspection and stores, or equivalent organizations. Training should include both classroom and at least some "hands-on" aircraft training for those personnel who are assigned aircraft maintenance duties. Otherwise, training may be performed in a classroom, by computer based training, in simulators, in an airplane or in any other effective combination of the above consistent with the approved program, and considered acceptable to FAA.

2) Subject areas for training should include: Operational concepts, aircraft types and systems affected, aircraft variants and differences where applicable, procedures to be used, manual or technical reference availability and use, processes, tools or test equipment to be used, quality control, methods for testing and return to service, signoffs required, proper Minimum Equipment List (MEL) application, general information about where to get technical assistance as necessary, necessary coordination with other parts of the operator's organization (e.g., flight operations, dispatch), and any other maintenance program requirements unique to the operator or the aircraft types or variants flown (e.g., human factors considerations, problem reporting).

3) Procedures for the use of outside vendors or vendor's parts that ensures compatibility to program requirements and for establishing measures to control and account for parts overall quality assurance.

4) Procedures to ensure tracking and control of components that are "swapped" between systems for trouble shooting when systems discrepancies can not be duplicated. These procedures should provide for total system testing and/or removal of aircraft from lower minimum status.

5) Procedures to assess, track and control the accomplishment of changes to components or systems pertinent to low visibility operations (e.g., ADs, service bulletins, engineering orders, 14 CFR requirements).

6) Procedures to record and report lower minimum operation(s) that are discontinued/ interrupted because of system(s) malfunction.

7) Procedures to install, evaluate, control, and test system and component software changes, updates, or periodic updates.

8) Procedures related to the minimum equipment list (MEL) remarks section use, which identify low visibility related systems and components, specifying limitations, upgrading and downgrading.

9) Procedures for identifying low visibility related components and systems as "required inspection items" (RII), to provide quality assurance whether performed in-house or by contract vendors.

**9.4 Test Equipment/Calibration Standards.** Test equipment may require periodic re-evaluation to ensure it has the required accuracy and reliability to return systems and components to service following maintenance. A listing of primary and secondary standards used to maintain test equipment that relate to low visibility operations should be maintained. It is the operator's responsibility to ensure these standards are adhered to by contract maintenance organizations. Traceability to a national standard or the manufacturer's calibration standards should be maintained.

**9.5. Return To Service Procedures.** Procedures should be included to upgrade or downgrade systems status concerning low visibility operations capability. The method for controlling operational status of the aircraft should ensure that flightcrews, maintenance and inspection departments, dispatch, and other administrative personnel as necessary are appropriately aware of aircraft and system status.

The appropriate level of testing should be specified for each component or system. The manufacturer's recommended maintenance program or maintenance instructions should be considered when determining the role built-in-test-equipment (BITE) should play for return to service (RTS) procedures, or for use as a method for low visibility status upgrade or downgrade.

Contract facilities or personnel should follow the operator's FAA approved maintenance program to approve an aircraft for return to service. The operator is responsible for ensuring that contract organizations and personnel are appropriately trained, qualified, and authorized.

**9.6 Periodic Aircraft System Evaluations.** The operator should provide a method to continuously assess or periodically evaluate aircraft system performance to ensure satisfactory operation for those systems applicable to Category II. An acceptable method for assuring satisfactory performance of a low visibility flight guidance system (e.g., autoland or HUD) is to periodically use the system and note satisfactory performance. A reliable record such as a logbook entry or computer ACARS record showing satisfactory performance within the previous 6 months for Category II is typically an acceptable method for assuring satisfactory system operation.

Periodic flight guidance system/autoland system checks should be conducted in accordance with procedures recommended by the airframe or avionics manufacturer, or by an alternate procedure approved by the FAA. For periodic assessment, a record should be established to show when and where the flight guidance/autoland system was satisfactorily used, and if performance was not satisfactory, to describe any remedial action taken.

Use of the flight guidance/automatic landing system should be encouraged to assist in maintaining its availability and reliability.

**9.7 Reliability Reporting And Quality Control.**

**9.7.1 Reliability Reporting -Category I.** No special "Reliability Reporting or Quality Control" requirements are applicable to Category I.

**9.7.2 Reliability Reporting -Category II.** For a period of 1 year after an applicant has been authorized for Category II, a monthly summary should be submitted to the certificate holding office. The following information should be reported:

**a.** The total number of approaches tracked, the number of satisfactory approaches tracked, by aircraft/system type, and visibility (RVR), if known or recorded.

**b.** The total number of unsatisfactory approaches, and reasons for unsatisfactory performance, if known, listed by appropriate category( e.g., poor system performance, aircraft equipment problem/failure; ground facility problem, ATS handling, lack of critical area protection, or other).

**c.** The total number of unscheduled removals of components of the related avionics systems.

**d.** Reporting after the initial period should be in accordance with the operators established reliability and reporting requirements.

**9.8 Configuration Control/System Modifications.** The operator should ensure that any modification to systems and components approved for low visibility operations are not adversely affected when incorporating software changes, service bulletins, hardware additions or modifications. Any changes to system components should be consistent with the aircraft manufacturer's, avionics manufacturer's, industry or FAA accepted criteria or processes.

**9.9 Records.** The operator should keep suitable records (e.g., both the operator's own records and access to records of any applicable contract maintenance organization). This is to ensure that both the operator and FAA can determine the appropriate airworthiness configuration and status of each aircraft intended for Category II operation.

Contract maintenance organizations should have appropriate records and instructions for coordination of records with the operator.

**9.10 FAR 129 Foreign Operator Maintenance Programs.**

**9.10.1 Maintenance of FAR 129 Foreign Registered Aircraft.** For part 129 operators of Foreign registered aircraft (e.g., 129.14 is not applicable), the cognizant CAA is the CAA of the operator. For those situations, FAA may implicitly accept that the maintenance program is considered to be acceptable if the cognizant CAA has approved it, and if the operator or CAA indicates that the program meets US criteria, US equivalent criteria (e.g., criteria such as JAA criteria), or ICAO criteria (e.g., Annex 6 and Doc 9365/AN910 "Manual of All Weather Operations"), and the cognizant CAA has authorized Category II US operations. FAA then issues the pertinent part 129 Category II OpSpec based on the other CAAs approval for that operator. However, FAA reserves the prerogative to assure competence of both the operator and authorizing and supervising CAA, depending on whether the CAA or operator are considered to be from a category 1, 2, or 3 country (safety classification not a low visibility landing classification), and if there have been any reported problems with the operator or CAA. Evidence of the operator satisfying or being consistent with the manufacturer's recommended maintenance program should serve as evidence of an acceptable maintenance program, regardless of the capability of the CAA or the operator, unless FAA has specifically addressed maintenance requirements beyond those of the manufacturer for that aircraft type (e.g., required service bulletin compliance or Airworthiness Directive compliance related to the flight guidance system).

**9.10.2 Maintenance of FAR 129 Foreign Operated U.S. "N" Registered Aircraft.** Foreign operators of U.S. "N" Registered Aircraft (e.g., those operators to which section 129.14 is applicable) should have maintenance programs equivalent to that required for a U.S. part 121 operator. Use of the part 91 provisions for General Aviation are not applicable or appropriate. POI Approval of Category II OpSpecs for a part 129.14 operator may implicitly be considered to also accept the maintenance program adequacy. Accordingly, coordination between the applicable POI and PMI is necessary before part 129 OpSpec authorization is completed. FAA is ultimately the cognizant CAA for the maintenance program in this instance, if the aircraft is N registered. FAA may however, accept the oversight of the operators CAA if that CAA is judged by FAA to have equivalent processes, criteria and procedures for oversight of maintenance programs (e.g., JAA countries). The basis for any such maintenance program should be the recommended airframe manufacturer (or avionics vendor) program, considering any adjusted MRB requirements.

**10. APPROVAL OF UNITED STATES OPERATORS.** Approval for Category I and II is through issuance of, or amendments to, OpSpecs. The authorizations, limitations, and provisions applicable to Category I and II operations are specified in Part C of the OpSpecs. Sample OpSpecs are provided in Appendix 7.

Operations specifications authorizing reciprocating and turbopropeller-powered airplane Category I operations that use ICAO standard NAVAIDs and ASRs and PARs are normally approved by the certificate holding district office without further review and concurrence, following satisfactory completion of the pertinent items below. Category I turbojet, turbofan and propfan normally require regional flight standards review and concurrence before approval. All Category II operations and operations using NAVAIDs which are not ICAO-standard NAVAIDs (e.g., Loran C, ARA, OSAP and TLS) normally require both regional flight standards and AFS-400 review and concurrence before approval.

**10.1. Operations Manuals and Procedures.** Appropriate Flightcrew Operating Manuals, Aircraft Flight Manuals, Policy Manuals, Aircraft Checklists, Quick Reference Checklists, Maintenance Manuals, Training Manuals or other equivalent operator documents (as necessary), must satisfactorily incorporate pertinent Category I and II provisions prior to Category I and II approval.

**a) Manuals.** Prior to approval, appropriate flightcrew operating manuals, flight manuals, airline policy manuals, maintenance manuals, training manuals, and related aircraft checklists, quick reference handbooks, or other equivalent operator information, must satisfactorily incorporate provisions pertinent to each category of operation.

Information covered in ground training, and procedures addressed in flight training should be available to flightcrews, and to dispatchers as applicable, in an appropriate form for reference use.

**b) Procedures.** Prior to approval of Category I or II operations, provisions of Section 6 of this Advisory Circular for procedures, duties, instructions, or any other necessary information to be used by flightcrews, or dispatchers as applicable, should be implemented by the operator.

Crewmember duties during the approach, flare, rollout, or missed approach should described. Duties should at least address responsibilities, tasks of the pilot flying the aircraft and the pilot not flying the aircraft during all stages of the approach, landing, rollout and missed approach. The duties of additional crewmembers, if required, should also be explicitly defined.

Specification of crewmember duties should address any needed interaction with dispatch or maintenance (e.g., addressing resolution of aircraft discrepancies and return to Category II/III service).

The applicant's qualification program should incorporate specific procedural responsibilities, appropriate to each category of landing minima being implemented, for the pilot in command and second in command in each of the ground training subject areas listed in paragraph 7.1, and each of the flight training subject areas listed in paragraph 7.2.

**10.2. Training Programs and Crew Qualification.** Training programs, AQP programs (if applicable), crew qualification and checking provisions and standards, differences qualification (AC 120-53) if applicable, check airmen qualification, line check, route check, and IOE programs should each satisfactorily incorporate necessary Category I and II provisions, as applicable (see sections 7.1 through 7.9). An acceptable method to track pertinent crewmember Category I and II qualification must be established.

For manually flown Category I and II systems (HUD FDs, etc.,) assure that provisions are made for each flight crewmember to receive the appropriate training, qualification, and line experience before that particular crewmember is authorized to use the pertinent Category I and II minima.

**10.3. Dispatch Planning (e.g., MEL, Alternate Airports, ETOPS).** Appropriate provisions for MELs and CDLs should be made as necessary to address Category I and II operations. Dispatch procedures to ensure appropriate weather, field condition, facility status, NOTAM information, engine-out MAP performance, crew qualification, aircraft system status, and fuel planning pertinent to Category I and II should be implemented. For ETOPS operations, a satisfactory method to address item 8.10 above should be demonstrated.

**10.4. Formulation of Operations Specification Requirements (e.g., RVR limits, DA(H) or MDA(H), equipment requirements, field lengths).** Proposed OpSpecs should list pertinent approved airports/runways, RVR limits, required transmissometers, DA(H) use provisions, "Inner Marker based DH" provisions (if applicable), aircraft equipment provisions for "normal" and, if applicable, "engine-out" operations, landing field length provisions, and any other special requirements identified by the CHDO or AFS-400 (ETOPS Category II, etc.). The operator's manuals, procedures, checklists, QRHs, MELs, dispatch procedures etc. must be shown to be consistent with the proposed OpSpecs.

**10.5 Operational/Airworthiness Demonstrations.** Appropriate "aircraft system suitability" and "operational use suitability" demonstrations must be completed as described in 10.5.1 and 10.5.2, unless otherwise specified by AFS-400. The purpose of these operational demonstrations is to determine or validate the use and effectiveness of the applicable aircraft flight guidance systems, training, flightcrew procedures, maintenance program, and manuals applicable to the program being approved. Operators of aircraft having FAA approved AFMs referencing this AC as the criteria used as the basis for Category I or II airworthiness demonstration already are considered to meet provisions of 10.5.1, and typically need only address provisions of 10.5.2. for verification of operational use suitability.

**10.5.1. Aircraft System Suitability Demonstration.** FAA regulations addressing low visibility takeoff and landing requirements and Category I and II are primarily operating rules addressed by parts 61, 91, 97, 121, 125, and 135. These provisions apply continuously, as defined at the time of a particular operation. Airworthiness rules (part 23, 25, etc.) primarily apply at the time a "certification basis" is established for TC or STC and do not necessarily reflect "present" requirements,

except through issuance of AD's. Accordingly, operationally acceptable demonstrations addressing suitability of aircraft systems for Category II, as applicable, must be successfully completed initially, and acceptable system status must be maintained by an operator to reflect compliance with current operating rules, to initially operate or continue to operate to Category II minima.

To minimize the need for repeating initial aircraft system operational suitability demonstrations for each operator, aircraft system suitability is usually demonstrated in conjunction with airworthiness approval (TC or STC) of aircraft system components such as flight guidance systems, autoland, flight directors, HUDs, flight instrument and alerting systems, radio altimeters, inertial systems, and air data systems. This approach to determination of aircraft system suitability is taken to optimize use of analysis and flight demonstration resources for operators, aircraft manufacturers, avionics manufacturers, and FAA. Accordingly, aircraft system suitability is normally demonstrated through an initial airworthiness demonstration meeting applicable provisions of Appendices to this AC (or combined airworthiness/operational evaluation for new systems or concepts, or where otherwise necessary).

However if such a demonstration has not been conducted during airworthiness certification, or the AFM accordingly does not reflect completion of such a Category II demonstration, then the operator may propose and the FAA may approve an assessment and demonstration program by the operator to establish Category II capability of an aircraft or flight guidance system. In such instances, criteria of Appendix 2 may be used as a guideline to formulate the operator's assessment and demonstration program. For such a program, the numbers of approaches conducted by the operator and the data collected to establish suitable performance and reliability should be equivalent to that which otherwise would be provided by an airworthiness demonstration in accordance with Appendix 2.

Airworthiness demonstration to an acceptable earlier version of AC 120-29, or equivalent criteria, may continue to be used for demonstration of aircraft/aircraft systems initially type certificated prior to issuance of this revision and having the earlier criteria as the type certification basis. However, previously demonstrated aircraft or aircraft systems seeking Category I or Category II credits specified only in provisions of this revised AC 120-29A (e.g., for HUD, or GNSS credit) must meet criteria specified in this AC.

Acceptable results of such airworthiness evaluations are usually described in AFM Section 3 (Normal and Non-Normal Procedures) of the FAA approved AFM or AFM Supplement.

For ILS precision approaches, basic type certification of an aircraft for "IFR" is considered to satisfactorily demonstrate Category I. For other systems or sensors, (HUD, GNSS etc.), other demonstrations per the Appendices of AC 120-29A may be requested for Category I. CHDOs should assure that aircraft proposed for Category II have completed an appropriate aircraft system operational suitability demonstration, and that result should normally be reflected in the approved AFM or AFM Supplement, unless operationally demonstrated as described above, or as otherwise specified by AFS-400.

For aircraft certified by FAA through section 21.29, certain Non-United States manufactured aircraft, any AFM provisions applicable to Category I may be assessed for suitability for an operators programs by AFM or equivalent Flight Operations Manual review. Assessment of provisions for Category II may vary and may require cordination between the CMO and AFS-400. In certain instances, AFM provisions may not be consistent with United States policy (Order 8400.10 or rules (Op-Specs) applicable to Category II. In such instances, CHDO coordination with AFS-400 is appropriate to provide appropriate guidance to operators regarding applicability of various AFM provisions (e.g., DH and RVR limitations, acceptable NAVAID use, alerting system use, required versus recommended crew procedures). As a general guideline, AFMs meeting airworthiness standards recognized by or harmonized with the FAA (e.g., JAA, Canada - DOT etc.) may typically be accepted without further demonstration.

In the event of consideration of an AFM of an aircraft certificated by a Non-U.S. airworthiness authority other than as described above, or for additional credit for existing systems based on uncertain foreign AFM provisions, operational assessments in accordance with criteria in this AC, or equivalent criteria, may be necessary. In such instances, the applicable AEG or AFS-400 should be consulted. If necessary AFS-400 may specify suitable criteria to apply.

**10.5.2. "Operator Use Suitability" Demonstration.**

For Category I, unless a CHDO otherwise specifies that approach demonstrations are necessary due to unusual circumstances or special situations, or as noted in 10.5.3 below for special systems such as "Autoland", operators may conduct Category I operations without need for special demonstrations, if the aircraft type AFM does not preclude the intended operation.

For Category II, at least one hundred (100) successful landings should be accomplished in line operations using the Category II or Category III system installed in each aircraft type, unless fewer approaches are determined to be appropriate by the CHDO. Examples of situations where fewer approaches than 100 may be authorized by the CHDO include credit for an operator also experienced in Category II or III operations, addition of a different or new aircraft type for an operator when that aircraft type already has successful Category II or III experience with a similar operator, or where the CHDO has consulted with AFS-400 and AFS-400 has determined that fewer approaches may apply (e.g., certain long range aircraft using Category III procedures and training, but with interim limitations to use Category II minima).

Regardless of credit permitted by he CHDO, if an operator is not aware of current Category II operations at a particular runway by some other operator and similar aircraft type, it is a good practice for the operator to have conducted at least one approach using the Category II or III system to each runway intended for Category II operations in weather better than that requiring use of Category II minima. Such demonstrations may be conducted in line operations, during training flights, or during aircraft type or route proving runs.

If an excessive number of failures (e.g., unsatisfactory landings, system disconnects) occur during the landing demonstration program, a determination should be made for the need for additional demonstration landings, or for consideration of other remedial action (e.g., procedures adjustment, wind constraints, system modifications).

The system should demonstrate reliability and performance in line operations consistent with the operational concepts specified in section 4. In unique situations where the completion of 100 successful landings could take an unreasonably long period of time due to factors such as a small number of aircraft in the fleet, limited opportunity to use runways having appropriate procedures, and equivalent reliability assurance can be achieved, a reduction in the required number of landings may be considered on a case-by-case basis. Reduction of the number of landings to be demonstrated requires a justification for the reduction, and prior approval from the Technical Programs Division (AFS-400).

Landing demonstrations should be accomplished on U.S. facilities or international facilities acceptable to FAA. However, at the operator's option, demonstrations may be made on other runways and facilities if sufficient information is collected to determine the cause of any unsatisfactory performance (e.g., critical area was not protected). No more than 50 percent of the demonstrations may be made on such facilities.

If an operator has different models of the same type of aircraft utilizing the same basic flight control and display systems, or different basic flight control and display systems on the same type of aircraft, the operator should show that the various models have satisfactory performance, but the operator need not conduct a full operational demonstration for each model or variant.

**10.5.2.1. Data Collection For Airborne System Demonstrations.** Each applicant should develop a data collection method (e.g., form to be used by flightcrew) to record approach and landing performance. The resulting data and a summary of the demonstration data should be made available to the CHDO for evaluation. The data should, as a minimum, include the following information:

(1) Inability to initiate an approach or identify deficiencies related to airborne equipment.

(2) Abandoned approaches. Give the reasons and altitude above the runway at which approach was discontinued or the automatic landing system was disengaged.

(3) This data should also include any system abnormalities which required manual intervention by the pilot to ensure a safe touchdown or touchdown and rollout, as appropriate.

**10.5.2.2. Data Analysis.** Unsatisfactory approaches using facilities approved for Category II or Category III where landing system signal protection was provided should be fully documented. The following factors should be considered:

(1) ATS Factors. ATS factors that result in unsuccessful approaches should be reported. Examples include situations in which a flight is vectored too close to the final approach fix/point for adequate localizer and glide slope capture, lack of protection of ILS critical areas, or ATS requests the flight to discontinue the approach.

(2) Faulty NAVAID Signals. NAVAID (e.g., ILS localizer) irregularities, such as those caused by other aircraft taxiing, over-flying the NAVAID (antenna), or where a pattern of such faulty performance can be established should be reported.

(3) Other Factors. Any other specific factors affecting the success of Category III operations that are clearly discernible to the flightcrew should be reported. An evaluation of reports discussed in subparagraphs 10.5.2.1(1), (2), and (3) will be made to determine system suitability for further Category III operations.

**10.5.3. Use of Autoland or Head-up-Guidance at US Type I Facilities or Equivalent (e.g., Type I ILS).**

For Category I, unless a CHDO otherwise specifies that autoland or HGS may not be used due to unusual circumstances or special situations, systems such as "Autoland" or "HGS" may typically be used at runways with facilities other than those with published Category II or III Instrument approach procedures. This is to aid pilots in achieving stabilized approaches and reliable touchdown performance to improve landing safety in adverse weather, for Category II or III training, to exercise the airborne system to assure suitable perfomance, for maintenance checks, or for other such reasons. Use of this capability may be particularly important for pilot workload relief in stressful conditions of fatigue after long international flights, night approaches, cross winds or turbulence, when there may be other aircraft non-normal conditions being addressed, or to aid safe landing performance in otherwise adverse weather, restricted visibility, or with cluttered runways. This is true even though reported visibility may be well above minima (e.g., heavy rain distorting view out the windshield, snow covered runways where markings are not easily visible).

Operators may conduct autoland or HGS operations at such facilities without need for special demonstrations, if the aircraft type AFM does not preclude the intended operation, and if for "Autoland" systems, Operations Specification Paragraph C61 is issued.. Precautions to be taken for such operations include the following:

1) The runway and associated instrument procedure should have no outstanding NOTAMs or other applicable "Notes" on the procedure precluding use of the autoland or HGS system (e.g., it should not have notes such as "Localizer unusable inside the threshold", or "Glide Slope unusable below xxx feet"),

2) Suitable ILS "Critical Area protection" (or equivalent) should be requested from ATS, if applicable. Similar to precautions for a Category II or III procedure, the crew should remain alert to detect any evidence of unsuitable system performance, whether or not critical protection is being provided,

3) The published ILS glide slope threshold crossing height (or equivalent) should be at least equal to or greater than that required for the aircraft type, and

4) The particular runway or procedure should not be precluded for "Autoland or HGS operations" by the operator due to known performance anomalies (e.g., not on a list of runways ineligible for or precluded from autoland or HGS operations as determined by that operator).

For minima credit for "Category II on Type I facilities", airborne systems including autoland or HGS are assessed for each particular aircraft type and specific runway, in accordance with 10.5.2 above.

**10.6. Eligible Airports and Runways.** For Category I, Airports and Runways are eligible as specified in part 97 SIAPs, ICAO accepted international procedures at foreign airports, or special procedures in OpSpecs. For Category II, an assessment of eligible airports, runways, and aircraft systems must be made in order to list appropriate runways on OpSpecs. For Category II, runways authorized for particular aircraft in accordance with existing operations listed on the AFS-400 Category II status checklist may be directly incorporated in OpSpecs, or incorporated by reference if published part 97 SIAPS are available. Aircraft type/runway combinations not shown should be verified by aircraft system use in line operations at

Category I or better minima, prior to authorization for Category II. Airports/aircraft types restricted due to special conditions (e.g., irregular underlying terrain) must be evaluated in accordance with Appendix 8, prior to OpSpec authorization.

If applicable, the operator should identify any necessary provisions for periodic demonstration of the aircraft system on runways other than those having Category II or III procedures (e.g., periodic autoland performance verification, using runways served only by a Category I procedure).

A status checklist for facilities which have special Category I and II provisions and published Category II or III procedures can be viewed on the Internet using the following address to access the FAAs Flight Standards Service home page:

**FAA Category II/Category III Status Checklist - http://www.faa.gov/avr/afshome.htm.**

To access this list, search the menu for Air Transportation and select All Weather Operations. The desired section can then be selected from the All Weather Operations home page menu.

**10.7. Irregular Pre-Threshold Terrain and Other Restricted Runways.** Airports/runways with irregular pre-threshold terrain, or runways restricted due to NAVAID or facility characteristics (see FAA Category II/Category III Status Checklist in Section 10.6) may require special evaluation, or limitations. CHDOs of operators desiring operations on these runways should contact AFS-400 to identify pertinent criteria and evaluation requirements. Various procedures used by FAA to assess irregular pre-threshold terrain are described in Appendix 8.

**10.8. Category II Engine-Inoperative Operations and ETOPS or EROPS Alternates based on Category II.** Low visibility landing minima are typically based on normal operations. For non-normal operations, flightcrews and aircraft dispatchers are expected to take the safest course of action to resolve the non-normal condition. The low weather minima capability of the aircraft must be known and available to the flightcrew and, if applicable, aircraft dispatcher.

In certain instances, sufficient airborne system redundancy may be included in the aircraft design to permit use of an alternate configuration such as “engine inoperative capability” for alternate planning or initiation of a Category II approach. Use of an engine inoperative configuration is based on the premise that the engine non-normal condition is an engine failure that has not adversely affected other airborne systems. Systems which should be considered include systems such as hydraulic systems, electrical systems or other relevant systems for Category II that are necessary to establish the appropriate flight guidance configuration.

An alternate engine inoperative configuration also is based on the premise that catastrophic engine failure has not occurred which may have caused uncertain, or unsafe collateral damage to the airframe, or aerodynamic configuration.

In instances when AFM or operational criteria is not met, and a Category II approach is necessary, because it is the safest course of action, (e.g., in flight fire), the flightcrew may use emergency authority. The flightcrew should determine to the extent necessary the state of the aircraft and other diversion options to ensure that an approach in weather conditions less than Category I is the safest course of action.

Four cases are useful in considering engine inoperative Category II capability, and engine inoperative approach authorization:

1. Flight planning (e.g., Dispatch consideration of takeoff, destination, or ETOPS or EROPS alternates) is based on aircraft configuration, reliability, and capability for "engine inoperative Category II" (see Section 10.8.2).

2. An engine fails en route, but prior to final approach (see Section 10.8.3).

3. An engine fails during the approach after passing the final approach fix, but prior to reaching the Decision Altitude (Height) (see Section 10.8.4).

4. An engine fails during approach after passing the Decision Altitude(Height) (see Section 10.8.5).

Section 5.17 provides criteria for demonstration of Category II engine out capability for the aircraft. Sections 10.8.1 through 10.8.5 below address criteria for use of an aircraft with "engine inoperative Category II" capability.

**10.8.1. General Criteria for Engine-Inoperative Category II Authorization.** Aircraft capability for "engine-inoperative Category II" should be approved in accordance with the provisions of paragraph 5.17, and if applicable, Appendix 2.

Regardless of whether an operator is or is not operationally authorized for "engine inoperative Category II", it must be clear that having this aircraft capability should not be interpreted as requiring a Category II landing at the "nearest suitable" airport in time (e.g., does not require landing at the nearest suitable Category II qualified airport - FAR 121.565).

POI's should ensure that the following conditions are met:

1. Operations must be in accordance with the "engine inoperative Category II" AFM provisions (e.g., within demonstrated wind limits, using appropriate crew procedures), or within operationally determined equivalent provisions and procedures, if not specified in the AFM.

2. Demonstrated/acceptable configurations must be used (e.g., AFDS modes, flap settings, electrical power sources, MEL provisions).

3. Engine-inoperative missed approach obstacle clearance from the TDZ must be ensured. Suitable information should be readily available for flight planning (e.g., to the pilot or aircraft dispatcher, if applicable).

4. Appropriate training program provisions for the Category II engine inoperative approaches must be provided (see paragraph 7.2.6).

5. Pilots must be aware that they are expected to take the safest course of action, in their judgment, in the event that unforeseen circumstances or unusual conditions occur that are not addressed by the "engine-inoperative" Category II demonstrated configuration (e.g., uncertain aircraft damage, possible fire, weather deterioration).

6. Operations Specifications should identify the type of "engine-inoperative" Category II operations authorized. Types of operations are described in sections 10.8.2 through 10.8.5 below.

**10.8.2. Category II Engine Inoperative "Flight Planning."** The operator (e.g., pilot or if applicable, aircraft dispatcher) may consider "engine inoperative Category II" capability in planning flights for a takeoff alternate, en route (ETOPS or EROPS) alternate, re-dispatch alternate, destination, or destination alternate only if each of the following conditions are met:

1. The operator (e.g., pilot or aircraft dispatcher, if applicable) has determined that the aircraft is capable of engine inoperative Category II.

2. Appropriate procedures, performance, and obstacle clearance information must be provided to the crew to be able to safely accomplish an engine inoperative missed approach at any point in the approach. If applicable, similar information must also be readily available to the aircraft dispatcher.

3. Appropriate operational weather constraints must be considered and specified as necessary regarding cross wind, head wind, tail wind limits considering the demonstrated capability specified in the AFM, or equivalent operationally demonstrated or specified provisions.

4. Weather reports or forecast must indicate that specified alternate minimums or landing minimums will be available for the runway equipped with appropriate Navaid and lighting systems and Category II procedures. The operators use of engine inoperative capability credit should consider both the availability and reliability of meteorological reports and forecasts, the time factors involved in potential forecast accuracy, the potential for variability in the weather at each pertinent airport, and the ability for the crew and, if applicable, aircraft dispatcher to

obtain timely weather reports and forecast updates during the time the flight is en route. Flight planning considerations must account for any expected ATS delays that might be experienced during arrival due to weather, snow removal, or other factors.

5. Notices to airmen or equivalent information for airport and facility status should be reviewed to ensure that they do not preclude the accomplishment of a safe engine inoperative approach on the designated runway using approved Category II procedures (e.g., temporary obstructions). Any change in NOTAM status of facilities related to use of landing minima or alternate minima must be provided to the crew in a timely manner while en route.

6. If the engine inoperative configuration is different than a normal landing configuration, a means to determine that a safe landing distance is achievable should be addressed, considering the pertinent engine inoperative aircraft configuration. This assessment is to ensure that sufficient runway is available consistent with the expected flap setting(s), speeds, and reverse thrust available configuration, or other factors that could pertain to an inoperative engine landing (e.g., reduced flap settings may be necessary for an engine inoperative approach).

7. The expectation for runway surface condition based on pilot and operator (e.g., aircraft dispatcher) interpretation of the available weather reports, field conditions, and forecasts is that the applicable runway is likely to be free from standing water, snow, slush, ice, or other contaminants at the time of landing. The flightcrew must be advised of any adverse change in this expectation while en route.

8. Criteria otherwise applicable to "all engine" Category II, such as flightcrew or dispatcher training, crew qualification, and availability of suitable procedures must also be addressed for the engine inoperative landing case, if they are not the same as for the “all engine” case.

9. The operator is approved for operations based on engine inoperative Category II capability. In addition, operator responsibilities for engine inoperative credit should be equivalent to that of current normal operations when an en route landing system failure causes degraded landing capability. If an inflight failure causes further degradation of engine inoperative landing capability, the flightcrew (if applicable, in conjunction with the aircraft dispatcher) should determine an acceptable alternative course of action (e.g., specification of different en route diversion options, revised fuel reserves plan, or revised flight plan routing).

10. When engine inoperative Category II provisions are applied to identification of any destination or destination alternate, more than one qualifying destination alternate is required. This is to provide for the possibility of adverse area wide weather phenomena, or unexpected loss of landing capability at the first designated alternate airport.

11. An appropriate ceiling and visibility increment is added to the lowest authorized minimums when credit for an alternate airport or airports is sought (e.g., 200 ft. DA(H) additive and appropriate RVR additive; see Appendix 7 - Operations Specification Example).

12. The airborne system should be shown through "in-service" performance that from takeoff to 500’ HAT on approach, system availability is at least 95%.

It should be noted that even if the aircraft, flightcrews, and operator are authorized for engine inoperative Category II, flightcrews are not required to use Category II approach minima to satisfy requirements of section 121.565 regarding in-flight diversions. Not withstanding section 121.565, pilots may elect to take a safe course of action by landing at a more distant airport than one at which a Category II approach may be available. Conversely, pilots may elect to conduct the Category II approach as the safest or a safe course of action.

**10.8.3. Category II Engine Inoperative En Route.** For engine failure en route, a pilot may initiate an "engine inoperative" Category II approach under the following conditions:

1. The airplane flight manual normal or non-normal sections, or equivalent provisions of an operators manual specify that engine inoperative approach capability has been demonstrated and procedures are available.

2. The pilot and, if applicable, aircraft dispatcher have taken into account the landing runway length needed for the inoperative engine configuration and corresponding approach speeds, and obstacle clearance can be maintained in the event of a missed approach.

3. The pilot and, if applicable, aircraft dispatcher have determined that the approach can be conducted within the wind, weather, configuration, or other relevant constraints demonstrated for the configuration.

4. The pilot and, if applicable, aircraft dispatcher have determined from interpretation of the best available information that the runway is expected to be free from standing water, snow, slush, ice, or other contaminants.

5. The pilot is confident that the aircraft has not experienced damage related to the engine failure that would make an engine inoperative Category II approach unsuccessful, or unsafe.

6. The operator is approved and the pilot is qualified to conduct a Category II engine inoperative approach.

7. The pilot and, if applicable, aircraft dispatcher consider that conducting a Category II approach is a safe and appropriate course of action.

**10.8.4. Category II Engine Failure During Approach, Prior to Decision Altitude(Height).** If the aircraft, operator, and crew meet paragraphs 5.17 for the aircraft and sections 10.8.2 or 10.8.3 for operational use, a Category II approach may be continued if an engine failure is experienced after passing the final approach fix.

In the event that an aircraft has not been demonstrated for engine inoperative Category II approach capability, or the operator or crew have not been authorized for Category II engine inoperative approaches, then, regardless of flight phase, continuation of an approach in the event of an engine failure is permitted only in accordance with the emergency authority of the pilot to select the safest course of action.

NOTE: For some aircraft configurations, it may be necessary to discontinue the approach after passing the final approach fix or final approach point; re-trim the aircraft for an inoperative engine, and then re-initiate the approach in order to be able to appropriately complete a satisfactory Category II approach and landing.

**10.8.5. Category II Engine Failure After Passing Decision Altitude(Height).** If an engine fails after passing the Decision Altitude(Height), the procedure specified in the airplane flight manual, or a procedure specified by the operator in the operator's manual for normal or non-normal operations should be followed. Any Category II approval must consider the case of engine failure at, or after, DA(H). Standard operations specifications are considered to address this case. "Engine inoperative Category II capability" is not specifically a factor in determining response to this situation.

**10.8.6. Operators using Combined Category II and Category III Engine-Inoperative Approach Provisions.** Unless otherwise specified by FAA, Category II and Category III engine inoperative authorizations and procedures may combined when the operator meets the more stringent criteria of AC120-28D for Category III. Separate showing for AC120-29A and AC120-28D is not necessary beyond any inherent differences between Category II and III operations (e.g., application of a DA(H) for Category II versus an Alert Height for certain Category III operations). Operational suitability demonstration programs, qualification programs, and operational provisions may be simultaneously established and used as long as procedures and systems applicable to the respective Category II and Category III capability and minima are appropriately applied. Eligible minima for any particular engine-inoperative operation should be no lower than the highest applicable authorized minima for the aircraft, crew, airport, procedure, or applicable operation-specification limitation.

**10.9. New Category II Operators.** New operators should follow demonstration period provisions of 10.5.2. Additionally, typical acceptable minima step down provisions approvable by FAA are as follows:

Starting from "limited Category I" (e.g., 300 feet DA(H) and 3/4 mile visibility) to lowest Category I minima (e.g., 200 feet DA(H) and RVR 1800):

First 250 feet DA(H) and RVR3000, and then DA(H) 200 feet and RVR1800

Starting from Category I to Category II:
First DH 100/RVR1600, then DH 100 and RVR1200

Starting from Category I for Category III:
See AC120-28D.

Each runway/procedure not already being used by any operator of a similar type aircraft should be successfully demonstrated by a line service or an evaluation approach using the Category II system and procedures, in Category I or better conditions, for each applicable aircraft/system type (e.g., B767, L1011). In addition, the operator must address special airports/runways as noted in the FAA Category II/Category III Status Checklist.

**10.10. Credit for Experienced Category II or Category III Operators for New Category II Authorizations.** Experienced operators are considered to be those operators having successfully completed their initial 6 month/ 100 Category II or III approach or landing demonstration period, and have current OpSpecs authorizing use of lowest applicable or intended Category II minima.

Sections 10.10.1 through 10.10.3 below address examples of program changes where "experienced operator" credit may apply.

Operators authorized for Category II using one class of system (e.g., autopilot) but who are introducing a significantly different class of system as the basis for a Category II authorization (e.g., manually flown Category II approaches using a HUD) are typically considered to be "New operators" for the purposes of demonstration period provisions and acceptable minima "step down" provisions for that class of system (see section 10.9).

**10.10.1. Category I or II At New Airports/Runways.** For ILS or MLS, Category I or II operations may be conducted at facilities with a published part 97 SIAP, or equivalent, or with a "Special" instrument approach procedure typically without additional demonstration. For GLS, Category I operations may be conducted at facilities with a published part 97 SIAP, or with a "Special" instrument approach procedure or equivalent for the particular operator(s) authorized to use the "special" procedure typically without additional demonstration. For other navaid systems or operator combinations (e.g., initial GLS Category II, other operators desiring to use a special instrument procedure developed by a different operator, TLS) demonstration of capability at new airport/runway is typically appropriate as determined by the CHDO. However, standard or special procedures for Category II other than those based on ILS or MLS may be added to an experienced Category II operators OpSpecs for a similar procedure without further demonstration if the same or equivalent aircraft/aircraft system and procedure for the approach is already used by that operator or is shown on the FAA's Category II status checklist as being conducted at that facility by another operator with similar aircraft or airborne system (e.g., acceptable HUD, GNSS operations). Otherwise, the operator may be requested by the CHDO to accomplish one or more line service landings at Category I or better minima to assure satisfactory performance before authorizing Category II minima. Special runways on the FAA Category II status checklist (e.g., Irregular Terrain runways) typically require special evaluation for each aircraft or system type (See Section 10.7).

**10.10.2. Category II With New Aircraft Systems.** Unless otherwise specified by AFS-400, experienced Category II operators may initially use new or upgraded aircraft system capabilities/components to the lowest authorized minima established for those systems or components, or use reduced length demonstration periods, consistent with the new aircraft systems to be used, FAA FSB requirements, and NAVAIDs, runways, and procedures to used (e.g., New Category II HUD installations on B737-300s previously authorized for Category II for that operator based on autoland)

**10.10.3. Adding a New Category II Aircraft Type.** Experienced Category II operators may operate new or upgraded aircraft types/systems, or derivative types, using reduced length demonstration periods (e.g., less than 6 months/ 100 landings) when authorized by AFS-400. Demonstration requirements are established considering any applicable FAA FSB criteria, applicability of previous operator service experience, experience with that aircraft type by other operators, experience of crews of that operator for Category II and the type of system, and other such factors, on an individual basis. Appropriate minima reduction steps may also be established for an abbreviated demonstration period, consistent with prior

operator experience, NAVAIDs and runways used, and procedures to be used, etc. (e.g., Newly acquired B757s being added to Category II OpSpecs, in addition to an operator's currently approved Category II A300 and MD-80 fleets).

**10.11. Category II Program Status Following Operator Acquisitions/Mergers.** Category II operators involved in acquisitions of other operators, or mergers, and their respective CHDOs, must assure compatibility of programs, procedures, aircraft systems, runways served and any other relevant issues before amending OpSpecs, or advising the surviving or controlling operator of the status of Category II OpSpecs of the acquired or merged operator. If CHDO doubt exists regarding applicability or status of Category II OpSpec provisions for a resulting new, surviving, acquired, or merged carrier, AFS-400 should be consulted.

**10.12. Initiating Combined Category I and II, or Category I, II, and III Programs for New Equipment Types.** When appropriate provisions of this AC, as amended, are used for Category I and II programs for a new equipment type (e.g., HUD) those programs may be initiated simultaneously for either a new Category II or Category II/III operator, or for an existing operator currently approved for Category II or III using other systems (e.g., ILS/FD).

**10.13. United States Carrier Category I and II Operations at Foreign Airports.** An applicant having U.S. Category I approval may be authorized to use that minima at foreign airports in accordance with its OpSpecs and Order 8260.31.

Once approved, the operator must comply with both FAA and local requirements. The operator must also ensure current status information for NOTAMs are available and advise its CHDO of incompatible requirements (use of OCA (H) etc.) for resolution by CHDO or AFS-400.

Although it is recognized that the systems at foreign airports may not be exactly in accordance with U.S. standards, it is important that any foreign facilities used for Category II provide the necessary information or functions consistent with the intent of the U.S. standards. Carriers desiring Category II approvals at foreign airports or runways not on the FAA-approved list should submit such requests through its FAA principal operations inspector to the Technical Programs Division, AFS-400, FAA Headquarters, Washington, D.C.

Figure 10.13-1 provides a checklist for carriers use to facilitate approval of Category II/III operations at facilities listed in the controlling states Aeronautical Information Publication (AIP). It should be used to ensure suitability of the intended facility and to verify conformance or equivalence with U.S. standards at non-U.S. airports. Completion of this checklist must reflect achieved or completed status - not planned actions. For ICAO states that do not maintain an AIP, a copy of the NOTAM, obstruction data, and/or a reliable and regular method of correspondence with the charting services used by U.S. certificate holders must be attached.

## FACILITY CHECKLIST FOR CATEGORY II/III
**(FOR NON-US FACILITIES)**

AIRPORT (ICAO ID): _____ COUNTRY: _____ DATE: _____

Runway: _____ Length: _____ Width: _____ G/S Angle (deg.): _____

Lowest Minima _____ (ft/m) Runway TCH _____ (ft/m)

Special Limitations (if any):
_____.
LIGHTING:
Approach _____ TDZ _____ Centerline ____ HIRL ____ Stopbars _____

Other (e.g., PAPI):
_____.

MARKINGS:
Runway_____ Taxiway_____ Other (e.g., Taxiway Position) _____

Critical Area Protection Policy (ceiling/visibility or conditions):
LOC _____ G/S _____

METEROLOGICAL DATA: METARs _____ TAFs _____
TRANSMISSOMETERS:

(Locations/Lowest RVR reported /readout step increment)

Touchdown _____ Mid _____ Rollout _____

OBSTRUCTION CLEARANCE ASSESSMENT COMPLETION DATE: _____
Verified by: certificate holder _____, "state of the aerodrome" _____, other _____
Irregular terrain a factor (Y/N): _____ Similar type aircraft currently operate (Y/N) _____

NOTAM SOURCE/CONTACT: _____
FIELD CONDITIONS SOURCE/CONTACT _____

Attached procedure has been developed in accordance with:
FAA Handbook 8260.3B (TERPS) ____ ICAO PANS-OPS Doc. 8168-OPS/611, Vol-11 ____
Other Criteria Accepted by FAA ____ (indicate criteria) _____

Facility reviewed in accordance with ICAO Manual of All Weather Operations, as revised
(DOC 9365/AN910) Chapters 3, 5, and 6 DATE REVIEW COMPLETED: _____

Name: _____
Title: _____
Signature: _____
Date: _____

Attachments List:

**Figure 10.13 - 1**

**10.14. Category I and II Operations on Off-Route Charters.** Unless otherwise specified by AFS-400, experienced Category I operations using non-traditional systems (HUD, GNSS etc.) and Category II operators may receive authorization to use Category I and II minima at United States off-route charter airports and runways as follows:

The runway has a published part 97 SIAP, or equivalent, or

The runway must be on the FAA Category II status checklist, and not require special evaluation, or

The aircraft used must be the same as or equivalent to an aircraft already using the facility by other United States operators (e.g., an off route charter with a B737/GNSS) could operate to runways having Category I and II Operations by an other operators B737-300 using same or equivalent system).

The OpSpec must authorize off-route charter Category I or II procedures, and

If applicable, the CHDO must be advised of the specific airports, aircraft, crew qualifications and any special provisions to be used, prior to the intended operation.

**10.15. Approval of Category I and II Minima.** Applicants should submit documentation requesting approval to the FAA CHDO or FSDO responsible for that operator's certificate. The application should demonstrate compliance with the appropriate provisions of applicable sections of this AC, particularly Sections 7 through 12. Proposed OpSpecs provisions should be included with the application.

Following FAA concurrence, as described in paragraph 10 above, OpSpecs authorizing Category I or II minima may be issued (see Appendix 7 for sample OpSpecs examples).

During the period following the issuance of new or revised OpSpecs for Category II (typically 6 months), the operator must successfully complete a suitable operations demonstration and data collection program in "line service" for each type aircraft, as the final part of the approval process.

The approval process is considered to be completed following a successful demonstration period. This is to ensure appropriate performance and reliability of the operator’s aircraft, procedures, maintenance, airports, and NAVAIDs. This process must be completed before operations down to lowest requested minima are authorized. Section 10.5 addresses appropriate demonstration process criteria.

When the data from the operational demonstration has been analyzed and found acceptable, an applicant may be authorized the lowest requested minima consistent with this AC and applicable standard OpSpecs. Examples of minima step down provisions acceptable to FAA are provided at paragraphs 10.9 and 10.10.

**10.16. Operations Specification Amendments.** The operator is responsible for maintaining current OpSpecs reflecting current approvals authorized by FAA. Once FAA has authorized a change for aircraft systems, new runways, or other authorizations, appropriate and timely amendments to affected OpSpecs should be issued. Issuance of amendments to guidance or procedures in other related material such as the Flight Operations Manual or Training Program may also be required. When updated standard OpSpecs provisions are adopted by FAA, provisions of those updated OpSpecs should normally be applied to each operator's program in a timely manner.

**10.17. Use of Special Obstacle Clearance Criteria (e.g. MASPS, or non-standard RNP Criteria).** This paragraph addresses use of special criteria such as "Required Navigation Performance" (RNP) criteria. Pending implementation of RNP criteria for public use Standard Instrument Approach Procedures (SIAPS), obstacle assessments using RNP criteria will be conducted on a case-by-case basis, only authorized as an element of special procedures for RNP qualified operators, using RNP qualified aircraft. Early application of RNP for special procedures is typically intended to apply to instrument procedure segments classified as a transition to a final approach segment, or to facilitate definition of suitable missed approach segments. Use of special obstacle clearance criteria or non-standard RNP criteria must be approved by AFS-400.

**10.18. Proof-of-Concept Requirements for New Systems/Methods.** Proof-of-Concept demonstration [POC] as used in this AC is defined as a generic demonstration in a full operational environment of facilities, weather, crew complement, aircraft systems and any other relevant parameters necessary to show concept validity in terms of performance, system reliability, repeatability, and typical pilot response to failures as well as to demonstrate that an equivalent level of safety is provided.

Proof-of-Concept may be established by a combination of analysis, simulation and/or flight demonstrations in an operational environment. POC is typically a combined effort of FAA airworthiness and operational organizations with the applicant, with input from any associated or interested organizations.

A typical PoC program consists of the following elements:

1. Applicant submits a request to either FAA Aircraft Certification or Flight Standards.

2. Meetings are arranged to include all disciplines involved: Aircraft certification; Flight Standards; National Resource Specialists; the applicant, and supporting personnel as necessary (e.g., Air Traffic).

3. A test plan is established which includes input from applicable FAA organizations, the applicant, and as applicable, industry user groups.

4. The test plan should include as a minimum: system definition, operations procedures, qualification, training, weather and environment definition, normal, rare-normal, and non-normal conditions to be assessed, flightcrew, test subject, and test crew requirements, test procedures, test safety constraints as applicable, assessment criteria, and analysis, simulator and test aircraft requirements.

5. POC is conducted using agreed subject pilots, as appropriate.

6. POC data is collected in a real-time simulator environment and validated in a realistic airplane environment.

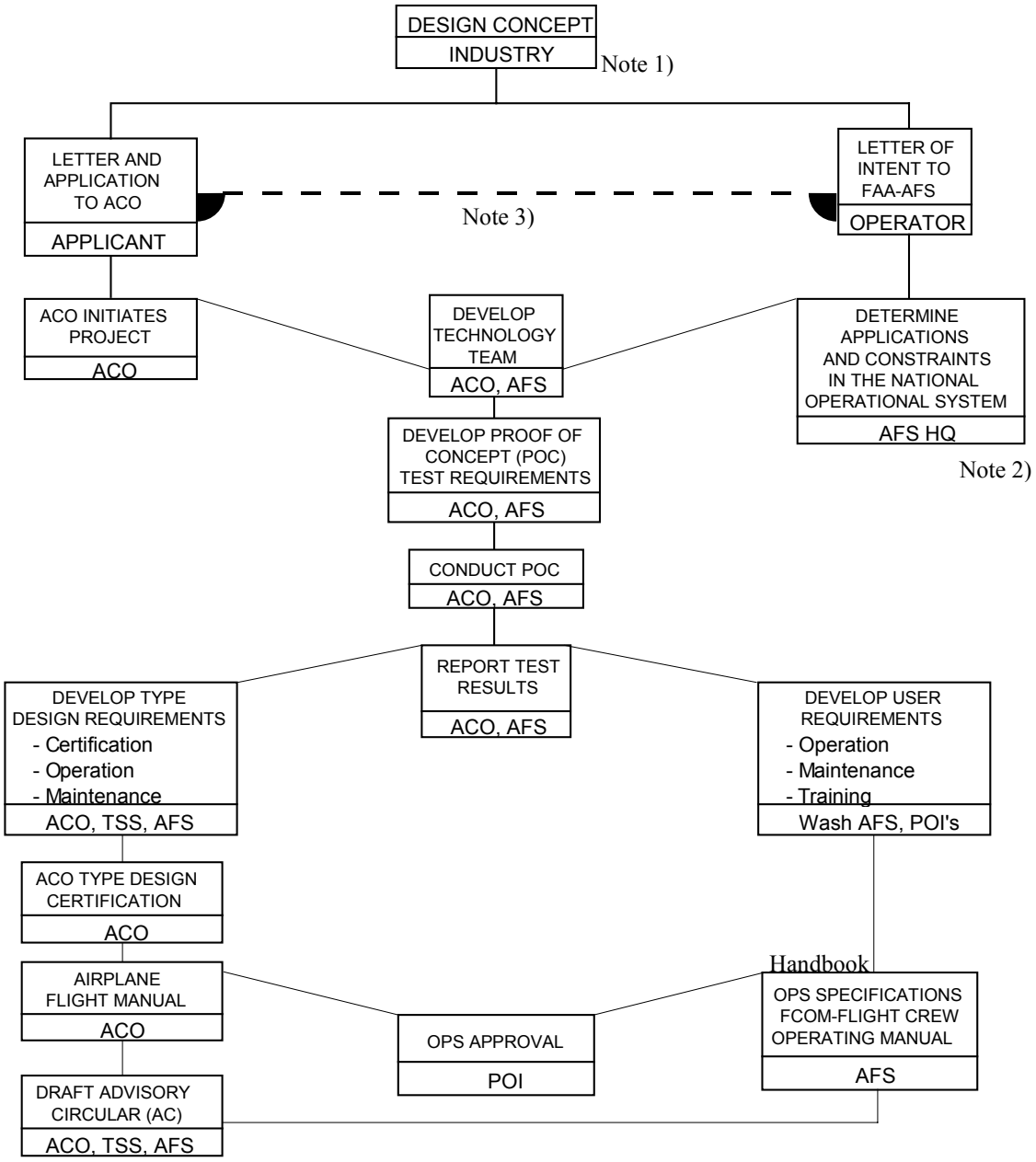
7. FAA is responsible for assessing the POC data that is typically provided to FAA as agreed by FAA and the applicant. FAA reports relevant findings to the applicant and if applicable, interested industry representatives.

8. FAA operations and airworthiness organizations use the data to develop criteria for approval of type designs, certification processes and procedures, operating concepts, facilities, flightcrew and maintenance qualification, OpSpecs, operations procedures, manuals, AFMs, maintenance procedures, and any criteria necessary.

9. FAA AC criteria for airworthiness and operational approval typically is a product of POC assessment.

This process is presented pictorially in the following figure:

# TECHNOLOGY DEVELOPMENT PROCESS




**Note:** 1) Futher modifications to the applicant's original Type Design may require additional technology revisions and/or follow on Proof of Concept testing.
2) The AFS group has the responsibility to coordinate with all Industry technology groups (ALPA, APA, ATA, Industry, manufactures, vendors, DOD, NASA, etc.)
3) Both the FAA ACO and FAA AFS should be contacted to provide certification and operational data to the respective offices.

**Index:** ACO - Aircraft Certification Office (Including Aircraft Evaluation Group)
AFS - Washington Flight Standards Policy Office
TSS - Transport Standards Staff

RRD7/19/94

### 10.19 RNP Qualification and Authorization

Operators may be authorized for RNP operations based on use of aircraft with an approved AFM specifying RNP capability. For such operations, in addition to AFM provisions, any provisions or constraints associated with that capability should be considered or applied (e.g., Aircraft or avionics manufacturer's guidance material, FCOM, or use assumptions made in associated documentation provided by the manufacturer to the operator or authority).

RNP authorizations for RNP capable aircraft as specified through an AFM may be generic and related directly to use of the provisions of the AFM (e.g., authorization to use RNP addresses any applicable AFM RNP levels and flight crew procedures).

Operators may be authorized for RNP operations based on "fleet qualification" specifying appropriate RNP capability. For such RNP operations, in addition to any necessary operator specific aircraft type provisions, navaid use constraints, area, route, or procedure constraints, should be applied, as necessary.

RNP authorizations for fleet qualified RNP aircraft typically should address authorized RNP levels, types of procedures, any necessary navaid use provisions, or other conditions or constraints as appropriate.

Authorization for use of RNP is through Operations Specifications.

For associated applicable provisions, also see Advisory Circular Sections 4.4 and 4.5.

## 11 FOREIGN AIR CARRIER CATEGORY I WITH SYSTEMS OTHER THAN ILS OR CATEGORY II AT UNITED STATES AIRPORTS (PART 129 OPERATIONS SPECIFICATIONS).

**11.1. Use of ICAO or FAA Criteria.** International operators requesting or authorized for Category II at U.S. airports should meet criteria of 11.1.1 through 11.1.3 below.

**11.1.1. Acceptable Criteria.** Criteria Acceptable for use for assessment of international operator's applications for Category II at U.S. airports includes this AC, equivalent JAA criteria, or the ICAO Manual of All Weather Operations DOC 9365/AN910, as amended.

International operators previously approved by FAA in accordance with earlier criteria may continue to apply that earlier criteria. International operators seeking credit for operations addressed only by this revision of AC 120-29A (e.g., Category II HUD operations) must meet criteria of this AC, or equivalent criteria acceptable to FAA, for those applicable provisions.

**11.1.2. Foreign Operator AFM Provisions.** Unless otherwise authorized by FAA, aircraft used by international operators for Category II within the U.S. should have AFM provisions reflecting an appropriate level of Category II capability as demonstrated to or authorized by FAA, or demonstrated to or authorized by an authority recognized by FAA as having acceptable equivalent Category II airworthiness criteria (e.g., European JAA, Canada MOT, UK CAA).

**11.1.3. Foreign Operator Category II Demonstrations.** International (Foreign) Air Carriers meeting FAA criteria, or criteria acceptable to FAA (e.g., European JAA, ICAO Criteria including Doc 9365/AN910), and having more than six months experience in use of Category II operations with the applicable aircraft type may be approved for Category II in accordance with provisions of their own regulatory authority, or in accordance with standard provisions of part 129 OpSpecs, which ever is the more restrictive.

For international (foreign) operators not having the above experience, FAA will confer with the authority of the state of the operator and with the operator to jointly determine suitable provisions for a U.S. Category II authorization for that operator. International (Foreign) Air Carriers not meeting above provisions may be subject to the demonstration requirements of 10.5.2 and 10.9 equivalent to those necessary for U.S. operators, as determined applicable by FAA.

**11.2. Issuance of Part 129 Operations Specifications.** International (Foreign) Air Carriers operating to U.S. airports that meet applicable provisions above are approved for Category II through issuance of part 129 OpSpecs (see Appendix 7).

Operators intending Category II operations at U.S. designated irregular terrain airports, or airports otherwise requiring special assessments must successfully complete those assessments prior to use of those facilities.

**11.3. Use of Certain Restricted United States Facilities.** Foreign Operator Category I and II operations may be conducted at facilities not having published Category I and II SIAPS, or may be conducted to minima lower than published on part 97 Category I and II SIAPS if they meet criteria equivalent to that required of a U.S. part 121 carrier, and they are approved by FAA, and the operations are acceptable to the authority of the State of the Operator. Similarly operations may be authorized at other special facilities identified on the FAA Category II/III Status checklist.

For such authorizations the following applies:

1) The Foreign operator and the pertinent authority of the State of that Operator must be advised of facility status,

2) Operator must be approved by the State of the Operator's Authority, and

3) FAA must have evidence from that authority that the operator is specifically authorized at that U.S. facility. Foreign operators typically use Category II procedures in the U.S. which are available as unrestricted public use procedures. However, FAA may also authorize certain restricted public use procedures and special Category II approach procedures for non-U.S. Operators. Typically, these procedures require special airborne equipment capability, special training, or non-standard facility and obstacle assessments. These special procedures are identified on the Category II/III status checklist and are not usually published as a part-97 Category II SIAP.

Foreign operators may be eligible to use certain of these procedures if they meet the same special criteria as would apply to a U.S. operator, and if they are approved by their own authority specifically for the use of the procedure. Some procedures may not be eligible for foreign use because of other applicable restrictions such as a restriction placed on private facility use. Special or restricted procedures require both FAA authorization and specific authorization from the state of the operator's controlling authority for each procedure. This is to assure that both the operator and foreign authority are aware of the special provisions needed, and to assure equivalent safety to use of standard ICAO criteria.

Each foreign operator seeking Category II procedure authorization at a facility not published as a standard and unrestricted Category II SIAP, or at any other facilities identified as special or restricted on the FAA Category II/III Status checklist, and that operator's controlling authority must:

1. Be aware of the restrictions applicable to the procedure (e.g., facility status),

2. Provide evidence to FAA of the controlling authority's approval of the operator for each special procedure requested, and

3. Must have the applicable limitations and conditions included in that operator's part 129 OpSpecs for each procedure to be used.

Foreign operators shall not normally be authorized special Category II operations to minima lower than those specified in part 97 Category II SIAPS consistent with ICAO criteria.

## 12. OPERATOR REPORTING, AND TAKING CORRECTIVE ACTIONS.

**12.1. Operator Reporting.** The reporting of satisfactory and unsatisfactory Category II aircraft performance is a useful tool in establishing and maintaining effective maintenance and operating policy and procedures. Additionally, when maintained over longer periods of time the report data substantiates a successful program and can identify trends, or recurring problems that may not be related to aircraft performance. Information obtained from reporting data and its analysis is useful in recommending and issuing appropriate corrective action(s).

Accordingly, for a period of at least 1 year after an applicant has been advised that its aircraft and program meet Category II requirements, and reduced minima are authorized, the operator is to provide a monthly summary to the FAA of the following information:

(1) The total number of approaches where the equipment constituting the airborne portion of the Category II system was used to make satisfactory (actual or simulated) approaches to the applicable Category II minima (by aircraft type).

(2) The total number of unsatisfactory approaches by airport and aircraft registration number with explanations in the following categories - airborne equipment faults, ground facility difficulties, aborts of approaches because of ATS instructions, or other reasons.

(3) Notify the certificate-holding office as soon as possible of any system failures or abnormalities that require flightcrew intervention after passing 100 feet during operations in weather conditions below Category I minima.

(4) Upon request, the CHDO will make this information available to AFS-400 for overall Category II program management, or to assist in assessment of program or facility effectiveness.

For an Extended Period.

**NOTE: The reporting burden contained in this AC does not require office of management and budget approval under the provisions of the Paperwork Reduction Act of 1980, according to Section 3502(4)(a).**

**12.2. Operator Corrective Actions.**

**All Programs.** Operators are expected to take appropriate corrective actions when they determine that aircraft, NAVAID, airport difficulties require program or minima adjustment.

At least the following factors should be considered: NAVAID status or performance problems, NOTAMs, airport facility status, air traffic procedure adjustments, lighting or marking system status, airport construction, adverse weather (snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas at non-United States airports, etc.), appropriate limitations or restrictions to minima necessary to assure safe operations.

**Category II.** In addition to the corrective actions contained above, for Category II the operations and maintenance manuals should address any corrections needed. Operators are expected to take appropriate corrective actions when they determine that conditions exist which could adversely affect safe Category II operations. Examples of situations for which an operator may need to take action restricting, limiting, or discontinuing Category II operations include: Repeated aircraft system difficulties, repeated maintenance write-ups, chronic pilot reports of unacceptable landing performance, applicable service bulletin issuance, ADs, NAVAID status or performance problems, applicable NOTAMs, airport facility status change, air traffic procedure adjustment, lighting, marking, or standby power system status outages, airport construction, obstacle construction, temporary obstacles, natural disasters, adverse weather, snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas, inability to confirm appropriate critical area protection at non-United States airports, and other such conditions.

Examples of appropriate corrective action could be an adjustment of Category II programs, procedures, training, modification to aircraft, restriction of minima, limitations on winds, restriction of NAVAID facility use, adjustment of payload, service bulletin incorporation, or other such measures necessary to assure safe operation.

# APPENDIX 1

# DEFINITIONS AND ACRONYMS

This Appendix contains the definition of terms and acronyms used within this Advisory Circular (AC). The appendix also contains certain terms that are not used in this Advisory Circular but are used in related Advisory Circulars and are included for convenient reference. Certain definition of terms and acronyms are also provided to facilitate common use of this Appendix for other related Advisory Circulars.

***[Ed Note: Review Appendix 8 for new/additional definitions/acronyms...]***

**Definitions**

| | |
|---|---|
| Actual Navigation Performance | A measure of the current estimated navigation performance, excluding Flight Technical Error (FTE).<br><br>Actual Navigation Performance is measured in terms of accuracy and integrity, and may be affected by the type and availability of navigation signals and equipment.<br><br>Note: Also see Estimated Position Uncertainty [EPU]. |
| Aeronautical Chart Critical data | Data for Aeronautical charts determined in accordance with RTCA or ICAO Annex 4 criteria considered to have a very low probability of significant error and very high probability of validity [e.g. $P_{error}$ per unit data element $<1 \times 10^{-8}$ ] |
| Aeronautical Chart Essential data | Data for Aeronautical charts determined in accordance with RTCA or ICAO Annex 4 criteria considered to have a low probability of significant error and high probability of validity [e.g. $P_{error}$ per unit data element $<1 \times 10^{-5}$ ] |
| Aeronautical Chart Routine data | Data for Aeronautical charts determined in accordance with RTCA or ICAO Annex 4 criteria considered to have a routine possibility of significant error and routine validity [e.g. $P_{error}$ per unit data element $<1 \times 10^{-3}$] |
| Approach Intercept Waypoint (APIWP) | A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a Final Approach Segment (FAS) that is fixed in space (e.g., an xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway. |
| Automatic Dependent Surveillance (ADS) | A surveillance technique in which aircraft automatically provide, via data link, data derived from on-board navigation and position fixing systems, including aircraft identification, four dimensional position and additional data as appropriate (ICAO - IS&RP Annex 6). |
| Alert Height | A height above the runway based on the characteristics of the aircraft and its fail-operational landing system, above which a Category III approach would be discontinued and a missed approach initiated if a failure occurred in one of the redundant parts of the fail operational landing system, or in the relevant ground equipment. (ICAO - IS&RP Annex 6). |
| Airborne Navigation system | The airborne equipment that senses and computes the aircraft position relative to the defined path, and provides information to the displays and to the flight |

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|---|---|
| | guidance system. It may include a number of receivers and/or system computers such as a Flight Management Computer and typically provides inputs to the Flight Guidance System. |
| Automatic Go-Around | A Go-Around which is accomplished by an autopilot following pilot selection and initiation of the "Go-Around" autopilot mode. |
| Availability | An expectation that systems or elements required for an operations will be available to perform their intended functions so that the operation will be accomplished as planned to an acceptable level of probability. |
| Balked Landing | A discontinued landing attempt. Term is often used in conjunction with aircraft configuration or performance assessment, as in "Balked landing climb gradient"; Also see "Rejected Landing". |
| Catastrophic Failure Condition | Failure Condition which would result in multiple fatalities, usually with the loss of the airplane. |
| Category I (US) | An instrument approach or approach and landing with a decision altitude (height) or minimum descent altitude (height) not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft). (adapted from ICAO - IS&RP Annex 6). |
| (ICAO) | A precision instrument approach and landing with a decision height not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft).<br><br>(adapted from ICAO - IS&RP Annex 6). |
| Category II | An instrument approach or approach and landing with a decision height lower than 60m (200 ft) but not lower than 30m (100 ft) and a runway visual range not less than 350m (1200 ft). (adapted from ICAO - IS&RP Annex 6). |
| Category III | An instrument approach or approach and landing with a decision height lower than 30m (100 ft), or no decision height, or a runway visual range less than 350m (1200 ft). (adapted from ICAO - IS&RP Annex 6). |
| Category IIIa | An instrument approach and landing with a decision height lower than 30m (100 ft), or no decision height and a runway visual range not less than 200m (700 ft). (adapted from ICAO - IS&RP Annex 6). |
| Category IIIb | An instrument approach and landing with a decision height lower than 15m (50 ft), or no decision height and a runway visual range less than 200m (700 ft) but not less than 50m (150 ft). (adapted from ICAO - IS&RP Annex 6).<br><br>FAA Note - the United States does not use Decision Heights for Category IIIb. |
| Category IIIc | An instrument approach and landing with or without a decision height, with a runway visual range less than 50m (150 ft).<br><br>(adapted from ICAO - IS&RP Annex 6). |
| Certificate Holding District Office (CHDO) | That FAA Flight Standards District Office (FSDO), Certificate Management Office (CMO), or Certificate Management Unit (CMU) assigned by FAA to have operating certificate oversight responsibility for a particular operator. |
| Class I Navigation | Navigation within the service volume of an ICAO Standard Navaid. |
| Class II Navigation | A flight operation or portion of a flight operation (irrespective of the means of navigation) which takes place outside (beyond) the designated Operational Service Volume of an ICAO standard airway navigation facility or Navaid (e.g. VOR, VOR/DME, NDB). |

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| Combiner | The element of the HUD in which the pilot simultaneously views the external visual scene along with synthetic information provided in symbolic form. |
| Command Information | Information that directs the pilot to follow a course of action in a specific situation (e.g., Flight Director). |
| Conformal Information | Information which correctly overlays the image of the real world, irrespective of the pilots viewing position. |
| Datum Crossing Height [DCH] | The height of the Flight Path Control Point (FPCP) above the Runway Datum Point (RDP).<br><br>Note: The FPCP may be specified in units of feet or meters, but is typically specified in units of feet. |
| Decision Altitude (DA) | A specified altitude in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. (Adapted from ICAO - IS&RP Annex 6). |
| Decision Altitude (Height) DA(H) | For Category I, a specified minimum altitude in an approach by which a missed approach must be initiated if the required visual reference to continue the approach has not been established. The "Altitude" value is typically measured by a barometric altimeter or equivalent (e.g., Inner Marker) and is the determining factor for minima for Category I Instrument Approach Procedures. The "Height" value specified in parenthesis is typically a radio altitude equivalent height above the touchdown zone (HAT) used only for advisory reference and does not necessarily reflect actual height above underlying terrain.<br><br>For Category II and certain Category III procedures (e.g., when using a Fail-Passive autoflight system) the Decision Height (or an equivalent IM position fix) is the controlling minima, and the altitude value specified is advisory. The altitude value is available for cross reference. Use of a barometrically referenced DA for Category II is not currently authorized for 14 CFR part 121, 129 or 135 operations at US facilities (Adapted from ICAO - IS&RP Annex 6). |
| Decision Height (DH) | A specified height in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established (Adapted from ICAO - IS&RP Annex 6). |
| Design Eye Box | The three dimensional volume in space surrounding the Design Eye Position from which the HUD information can be viewed. |
| Design Eye Position | The position at each pilot's station from which a seated pilot achieves the optimum combination of outside visibility and instrument scan. |

| | |
|---|---|
| Defined Flight Path | The flight path as determined by the path definition function of an aircraft's navigation system. |
| Desired Flight Path | The path that the pilot, or pilot and air traffic service, expect the aircraft to fly. |
| Enhanced Vision System (EVS) | An electronic means to provide the flight crew with a sensor derived or enhanced image of the external scene (e.g., Millimeter wave radar, FLIR). |
| Estimate of Position Uncertainty [EPU], or<br>Estimated Position Error [EPE] | A measure based on a scale which conveys the current position estimation performance - Also called Estimated Position Error (EPE) |
| Extended Final Approach Segment (EFAS) | That segment of an approach, co-linear with the Final Approach Segment, but which extends beyond the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP). |
| External Visual Reference | Information the pilot derives from visual observation of real world cues outside the cockpit. |
| Extremely Improbable | A probability of occurrence on the order of $1 \times 10^{-9}$ or less per hour of flight, or per event (e.g., takeoff, landing). |
| Extremely Remote | A probability of occurrence between the orders of $1 \times 10^{-9}$ and $1 \times 10^{-7}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Fail Operational System | A system capable of completing the specified phases of an operation following the failure of any single system component after passing a point designated by the applicable safety analysis (e.g., Alert Height). |
| Fail Passive System | A system which, in the event of a failure, causes no significant deviation of aircraft flight path or attitude. |
| Field of View | As applied to a Head Up Display - the angular extent of the display that can be seen from within the design eye box. |
| Final Approach Course (FAC) | The final bearing/radial/track of an instrument approach leading to a runway, without regard to distance. For certain previously designed approach procedures that are not aligned with a runway, the FAC bearing/radial/track of an instrument approach may lead to the extended runway centerline, rather than to alignment with the runway. |
| Final Approach Fix (FAF) | The fix from which the final approach to an airport is executed. For standard procedures that do not involve multiple approach segments intercepting the runway centerline near the runway, the FAF typically identifies the beginning of the straight-in final approach segment. |

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| Final Approach Point (FAP) | The point applicable to instrument approaches other than ILS, MLS or GLS, with no depicted FAF (e.g. only applies to approaches such as an on-airport VOR or NDB), where the aircraft is established inbound on the final approach course from a procedure turn, and where descent to the next procedurally specified altitude, or to minimum altitude, may be commenced. |
| Final Approach Segment (FAS) | The segment of an approach extending from the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Glidepath Intercept Reference Point (GIRP). For the purpose of procedure construction, The Final Approach segment is defined as beginning at the FAF and ending at the Flight Path Control Point (FPCP) or point at which the missed approach segment starts (e.g., point of lowest nominal DA(H)). |
| Flight Guidance System | The means available to the flight crew to maneuver the aircraft in a specific manner either manually or automatically. It may include a number of components such as the autopilot, flight directors, relevant display and annunciation elements and it typically accepts inputs from the airborne navigation system. |
| Flight Path Alignment Point (FPAP) | The FPAP is a point, usually at or near the stop end of a runway, used in conjunction with the RDP and a vector normal to the WGS-84 ellipsoid at the RDP, to define the geodesic plane of a final approach and landing flight path (e.g., FAS and RWS). The FPAP typically may be the RDP for the reciprocal runway. |
| Flight Path Control Point (FPCP) | The Flight Path Control Point (FPCP) is a calculated point located above the RDP in a direction normal to the WGS-84 ellipsoid. The FPCP is used to establish the vertical descent path and descent angle of the final approach flight path (e.g., FAS) to the landing runway. |
| Flight Technical Error (FTE) | The accuracy with which the aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or defined flight path position.<br>Note: FTE does not include human performance conceptual errors, typically which may be of large magnitude (e.g. entry of an incorrect waypoint or waypoint position, selection of an incorrect procedure, selection of an incorrect NAVAID frequency, failure to select a proper flight guidance mode. FTE can be influenced by factors such as flightcrew response to guidance (e.g., response to Flight Director information), or external environment conditions such as a wind gradient or turbulence). |
| "Fly By" Vertical Waypoint | A "Fly By" vertical waypoint (WP) is a WP for which an aircraft may initiate a vert rate or flight path angle change to depart the current segment of a specified vertical (VNAV path) shortly prior to an active WP, in order to expeditiously capture the ne vertical path segment without overshoot. |
| "Fly Over" Vertical Waypoint | A "Fly Over" vertical waypoint (WP) is a WP for which an aircraft must stay on the defined vertical path (VNAV path) until passing an active WP, and may not initiate capture of the next vertical path segment until after passing the active WP. |
| Frequent | Occurring more often than 1 in 1000 events or 1000 flight hours. |

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| Glide Path Angle [GPA] | The glide path angle is an angle, defined at the FPCP, that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the RDP, FPAP, and a vector normal to the WGS-84 ellipsoid at the RDP). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the RDP and a plane perpendicular to that vector at the FPCP, respectively. |
| Glide Path Intercept Waypoint (GPIWP) | The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in). |
| Glidepath Intercept Reference Point [GIRP] | The GIRP is the point at which the extension of the final approach path (e.g., FAS) intercepts the runway. |
| GNSS Landing System (GLS) | A differential GNSS (e.g. GPS) based landing system providing both vertical and lateral position fixing capability. Note: Term may be applied to any GNSS based differentially corrected landing system providing lateral and vertical service for approach and landing equivalent to or better than that provided by a U.S. Type I ILS, or equivalent ILS specified by ICAO Annex 10. |
| Global Positioning System [GPS] | The NAVSTAR Global Positioning System operated by the United States Department of Defense. It is a satellite -based radio navigation system composed of space, control and user segments. The space segment is composed of satellites. The control segment is composed of monitor stations, ground antennas and a master control station. The user segment consists of antennas and receiver-processors that derive time and compute a position and velocity from the data transmitted from the satellites. |
| Global Navigation Satellite System [GNSS] | A world wide position, velocity and time determination system that uses one or more satellite constellations. |
| Guidance | Information used during manual control, automatic control, or monitoring of automatic control of an aircraft that is of sufficient quality to be used by itself for the intended purpose of achieving a particular flight path . |
| Go-around | A transition from an approach to a stabilized climb. |
| Hazardous Failure Condition | Failure Conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be:<br>(i) A large reduction in safety margins or functional capabilities;<br>(ii) Physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely; or<br>(iii) Serious or fatal injury to a relatively small number of the occupants. |
| Head Up Display System | An aircraft system which provides head-up guidance to the pilot during flight. It includes the display element, sensors, computers and power supplies, indications |

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| | and controls. It may receive inputs from an airborne navigation system or flight guidance system. |
| Hybrid System | A combination of two, or more, systems of dissimilar design used to perform a particular operation. |
| Improbable | A probability of occurrence greater than $1 \times 10^{-9}$ but less than or equal to $1 \times 10^{-5}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Independent Landing Monitor (ILM) | A millimeter wave radar based sensor (e.g., typically transmitting at 35 GHz, or 94 Ghz) used to present a perspective display of a runway to a pilot on an electronic flight deck display during approach, to serve as an independent integrity monitor for another type of landing navaid sensor (e.g., ILS, MLS or GLS). |
| Independent Systems | A system that is not adversely influenced by the operation, computation, or failure of some other identical, related, or separate system (e.g., two separate ILS receivers). |
| Infrequent | Occurring less often than 1 in 1000 events or 1000 flight hours. |
| Initial Missed Approach Waypoint (IMAWP) | A Waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The IMAWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing. |
| Initial Missed Approach Segment (IMAS) | That segment of an approach from the Glide Path Intercept Waypoint (GIRP) to the Initial Missed Approach Waypoint (IMAWP). |
| Instantaneous Field of View | The angular extent of a HUD display which can be seen from either eye from a fixed position of the head. |
| Integrity | A measure of the acceptability of a system, or system element, to contribute to the required safety of an operation. |
| Landing | For the purpose of this AC, landing will begin at 100 ft., the DH or the AH to the first contact of the wheels with the runway. |
| Landing rollout | For the purpose of this AC, rollout starts from the first contact of the wheels with the runway and finishes when the airplane has slowed to a safe taxi speed (in the order of 30 knots). |
| Major Failure Condition | Failure Condition which would reduce the capability of the airplane or the ability o the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew workload or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries. |
| Minimum Descent Altitude(Height) | See individual definitions below for MDA and MDH. |
| [MDA(H)] | |
| Minimum Descent Altitude (MDA) | A specified altitude in a non-precision approach or circling approach below which descent must not be made without the required visual reference. Minimum Descent Altitude (MDA) is referenced to mean sea level. (ICAO - IS&RP Annex 6). |
| Minimum Descent Height | A specified height in a non-precision approach or circling approach below which descent must not be made without the required visual reference. Minimum |

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| (MDH) | Descent Height (MDH) is referenced to aerodrome elevation or to the threshold if that is more than 7 ft. (2m) below the aerodrome elevation. A MDH for a circling approach is referenced to the aerodrome elevation. (ICAO - IS&RP Annex 6).<br><br>FAA Note - The United States does not use Minimum Descent Heights. |
| Minimum Use Height (MUH) | A height specified during airworthiness demonstration or review above which, under standard or specified conditions, a probable failure of a system is not likely to cause a significant path displacement unacceptably reducing flight path clearance from specified reference surfaces (e.g. airport elevation) or specified obstacle clearance surfaces. |
| Minor Failure Condition | Failure Condition which would not significantly reduce airplane safety and which involve crew actions that are well within their capabilities. Minor Failure Conditions may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, such as routine flight plan changes, or some inconvenience to occupants. |
| Missed Approach | The flight path followed by an aircraft after discontinuation of an approach procedure and initiation of a go-around. Typically a “missed approach” follows a published missed approach segment of an instrument approach procedure, or follows radar vectors to a missed approach point, return to landing, or diversion to an alternate. |
| Missed Approach Segment (MAS) | That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated IMAWP, or missed approach holding WP, as specified for the procedure. |
| Monitored HUD | A HUD which has internal or external capability to reliably detect erroneous sensor inputs or guidance outputs, to assure that a pilot does not receive incorrect or misleading guidance, failure, or status information. |
| Navigation System Error | An error in the estimation of the aircraft's position. Also called "position estimation error". |
| Non-Normal Means of Navigation | A means of navigation which does not satisfy one or more of the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure or operation, and which may require use of a pilot's "emergency authority" to continue navigation. |
| Non-normal conditions | Conditions other than those considered normal conditions or rare-normal conditions (e.g. Failure conditions, certain kinds of error conditions ) |
| NOTAM | Notice to Airmen - A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (ICAO - IS&RP Annex 6). |
| Path Definition Error | The difference between the desired path and the defined path.<br><br>Note: This error may be due to survey errors, database resolution limitations, or other such factors. |
| Path Steering Error | Any resulting difference (i.e. non-zero deviation) between the estimated aircraft pos from the desired flight path.<br><br>Note: This error includes any display errors along with flight technical error. |

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| Performance | A measure of the accuracy with which an aircraft, a system, or an element of a system operates compared against specified parameters. Performance demonstration(s) typically include the component of Flight Technical Error (FTE). |
| Position Estimation Error | An error in the estimation of the aircraft's position. Also called "Navigation System Error". |
| Primary Means of Navigation | A means of navigation which satisfies the necessary levels of accuracy and integrity for a particular area, route, procedure or operation. The failure of a "Primary Means" of navigation may result in, or require reversion to a "non-normal" means of navigation, or an alternate level of RNP. |
| "Rare-Normal" conditions | A condition which must be expected to normally occur, but does so only very infrequently (e.g., unusually strong winds, significant wind gradients, significant turbulence, significant in-flight icing, significant mountain wave activity) |
| Redundant | The presence of more than one independent means for accomplishing a given function or flight operation. Each means need not necessarily be identical. |
| Rejected Landing | A discontinued landing attempt. A rejected landing typically is initiated at low altitude, but prior to touchdown. If from or following an instrument approach it typically is considered to be initiated below DA(H) or MDA(H). A rejected landing may be initiated in either VMC or IMC. A rejected landing typically leads to or results in a "go around", and if following an instrument approach, a "Missed Approach". If related to consideration of aircraft configuration(s) or performance it is sometime referred to as a "Balked Landing". The term "rejected landing is used to be consistent with regulatory references such as found in FAR121 Appendix E, and policy references as in FAA Order 8400.10. |
| Remote | A probability of occurrence on the order of greater than $1 \times 10^{-7}$ but less than or equal to $1 \times 10^{-5}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Required Navigation Performance (RNP) | A statement of the navigation performance necessary for operation within a defined airspace (Adapted from ICAO - IS&RP Annex 6).<br><br>NOTE: Required Navigation Performance is specified in terms of accuracy, integrity, and availability of navigation signals and equipment for a particular airspace, route, procedure or operation. |
| Required Navigation Performance Containment (RNP Containment) | RNP Containment represents a bound of the rare-normal performance and specified non-normal performance of a system, typically expressed as 2*RNP(X). When RNP represents Gaussian statistical performance at a level of two sigma (2 x standard deviation), then containment represents a nominal performance bound specified at the level of four sigma (4 x standard deviation). Note: RNP containment use may vary with intended operational applications. |
| Required Navigation Performance Level or Type (RNP Level or RNP Type) | A value typically expressed as a distance in nautical miles from the intended position within which an aircraft would be for at least 95 percent of the total flying time (Adapted from ICAO - IS&RP Annex 6).<br><br>NOTE: Applications of RNP to terminal area and other operations may also include a vertical and/or longitudinal component. ICAO may use the term RNP Type, while certain other States, aircraft manuals, procedures, and operators may use the term RNP Level.<br><br>Example - RNP 4 represents a navigation lateral accuracy of plus or minus 4 nm |

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| | (7.4 km) on a 95% basis. RNP is typically defined in terms of its lateral accuracy, and has an associated lateral containment boundary. |
| Required Visual Reference | That section of the visual aids or of the approach area which should have been in view for sufficient time for the pilots to have made an assessment of the aircraft's position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height, the required visual reference is that specified for the particular procedure and operations (ICAO - IS&RP Annex 6 - Decision Height definition - Note 2). |
| Runway Datum Point (RDP) | The RDP is used in conjunction with the FPAP and a vector normal to the WGS-84 ellipsoid at the RDP to define the geodesic plane of a final approach flight path to the runway for touchdown and rollout. It is a point at the designated lateral center of the landing runway defined by latitude, longitude, and ellipsoidal height. The RDP is typically a surveyed reference point used to connect the approach flight path with the runway. The RDP may or may not necessarily be coincident with the designated runway threshold |
| Runway Segment (RWS) | That segment of an approach from the glidepath intercept reference point (GIRP) to Flight Path Alignment Point (FPAP). |
| Situation Information | Information that directly informs the pilot about the status of the aircraft system operation or specific flight parameters including flight path. |
| Standard Landing Aid (SLA) | A Standard Landing Aid (SLA) is considered to be any navigation service or navigation aid provided by a State which meets internationally accepted performance standards (e.g., ICAO Standards and Recommended Practices (SARPs), or equivalent U.S. or other State standards). |

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| Supplementary Means of Navigation | A means of navigation which satisfies one or more of the necessary levels of accuracy, integrity, or availability for a particular area, route, procedure or operation. The failure of a "Supplementary Means" of navigation may result in, or require reversion to another alternate "normal" means of navigation for the intended route, procedure or operation. |
| Synthetic Reference | Information provided to the flight crew by instrumentation or electronic displays, that is electronically generated, processed, enhanced, or otherwise augmented. Information may be either command or situation information (e.g., SVS, EVS). |
| Synthetic Vision System (SVS) | A system used to create a synthetic image (e.g. typically a computer generated picture) representing the environment external to the airplane. |
| Take off Guidance System | A system which provides directional command guidance to the pilot during a takeoff, or takeoff and aborted takeoff. It includes sensors, computers and power supplies, indications and controls. |
| Total Field of View | The maximum angular extent of the display that can be seen with either eye, allowing head motion within the design eye box. |
| Total System Error (TSE) | The difference between the desired flight path and the actual flight path. Typically determined by a sum of the path definition error, navigation system error and the path steering error (i.e. flight technical error plus any display error). |
| Touch Down Zone (TDZ) | The first 3000 ft. of usable runway for landing, unless otherwise specified by the FAA, or other applicable ICAO or State authority (e.g for STOL aircraft, or in accordance with an SFAR). |
| Visual Guidance | Visual information the pilot derives from the observation of real world cues, out the flight deck window, used as a primary reference for aircraft control or flight path assessment. |
| WGS-84 Ellipsoid | A mathematical model of the earth's shape based on WGS-84 survey information, used as an element of an earth surface referenced navigation coordinate frame (See appropriate ICAO or RTCA references for its technical definition and specification - e.g., ICAO "World Geodetic System 1984 Manual - DOC 9674-AN/946"). |

## Acronyms

| ACRONYM | EXPANSION |
|---|---|
| ABAS | Aircraft Based Augmentation System |
| AC | Advisory Circular |
| ACI | Adjacent Channel Interface |
| ADF | Automatic Direction Finder |
| ADI | Attitude Director Indicator |
| ADS | Automatic Dependent Surveillance |
| AFCS | Autopilot Flight Control System |
| AFDS | Autopilot Flight Director System |
| AFGS | Automatic Flight Guidance System |
| AFM | Airplane Flight Manual |
| AH | Alert Height |
| AHI | All-Weather Harmonization Items |
| AIP | Aeronautical Information Publication |
| ALS | Approach Light System |
| ANP | Actual Navigation Performance |
| APIWP | Approach Intercept Waypoint |
| APM | Aircrew Program Manager |
| APU | Auxiliary Power Unit |
| AQP | Advanced Qualification Program |
| ARA | Airborne Radar Approach |
| ASR | Airport Surveillance Radar |
| ATC | Air Traffic Control |
| ATIS | Automatic Terminal Information Service |
| ATOGW | Allowable Takeoff Gross Weight |
| ATPC | Airline Transport Pilot Certificate |
| ATS | Air Traffic Service |
| AWO | All Weather Operations |
| BARO | [Abbreviation for "Barometric"] |
| BC | Back Course (e.g., ILS Back Course) |
| BITE | Built-In Test Equipment |
| CAA | Civil Aviation Authority |
| CDL | Configuration Deviation List |
| CFR | Code of Federal Regulations |

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| CFR | Crash Fire Rescue |
| CHDO | Certificate Holding District Office |
| CMO | [FAA] Certificate Management Office |
| CMU | [FAA] Certificate Management Unit |
| CL | Centerline Lights |
| CNS | Communication, Navigation and Surveillance |
| CRM | Collision Risk Model |
| CRM | Cockpit Resource Management |
| CVR | Cockpit Voice Recorder |
| DA | Decision Altitude |
| DA(H) | Decision Altitude(Height) |
| DCH | Datum Crossing Height |
| DD | DME-DME updating |
| DDM | Difference of Depth Modulation |
| DEP | Design Eye Position |
| DGNSS | Differential Global Navigation Satellite System |
| DH | Decision Height |
| DME | Distance Measuring Equipment |
| DOD | [U.S.] Department of Defense |
| DOT | [U.S.] Department of Transportation |
| DP | Departure Procedure |
| EADI | Electronic Attitude Director Indicator |
| ECEF | Earth Centered Earth Fixed (coordinate frame) |
| EFAS | Extended Final Approach Segment |
| EGPWS | Enhanced Ground Proximity Warning System |
| EHSI | Electronic Horizontal Situation Indicator |
| EPE | Estimated Position Error |
| EPU | Estimated Position Uncertainty |
| EROPS | Extended Range Operations (any number of engines) |
| ET | Elapsed Time |
| ET | Error Term [FMS use] |
| ETOPS | Extended Range Operations with Two-Engine Airplanes |
| EVS | Enhanced Vision System |
| FAF | Final Approach Fix |
| FAP | Final Approach Point |
| FAR | Federal Aviation Regulation |

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|---|---|
| FAS | Final Approach Segment |
| FBS | Fixed Base Simulator |
| FBW | Fly-by-wire |
| FCOM | Flight Crew Operating Manual |
| FDR | Flight Data Recorder |
| FGS | Flight Guidance System |
| FHA | Functional Hazard Assessment |
| FLIR | Forward Looking Infrared Sensor |
| FM | Frequency Modulation |
| FM | Fan Marker |
| FMC | Flight Management Computer |
| FMS | Flight Management System |
| FPAP | Flight Path Alignment Point |
| FPA | Flight Path Angle |
| FPCP | Flight Path Control Point |
| FSB | Flight Standardization Board |
| FSDO | [FAA] Flight Standards District Office |
| FSS | [FAA] Flight Service Station |
| FTE | Flight Technical Error |
| GA | Go-Around |
| GBAS | Ground Based Augmentation System |
| GCA | Ground Controlled Approach |
| GIRP | Glidepath Intercept Reference Point |
| GLS | GPS (or GNSS) Landing System |
| GNSS | Global Navigation Satellite System |
| GPA | Glide Path Angle |
| GPIWP | Glide Path Intercept Waypoint |
| GPWS | Ground Proximity Warning System |
| GPS | Global Positioning System |
| HAA | Height Above Airport |
| HAT | Height above Touchdown |
| HDG | Heading |
| HQRS | Handling Quality Rating System (see AC25-7A, as amended) |
| HUD | Head Up Display |
| IAP | Instrument Approach Procedure |

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| IAW | In Accordance With |
| ICAO | International Civil Aviation Organization |
| IFR | Instrument Flight Rules |
| IM | Inner Marker |
| IMAS | Initial Missed Approach Segment |
| IMAWP | Initial Missed Approach Waypoint |
| IMC | Instrument Meteorological Conditions |
| ILS | Instrument Landing System |
| INAS | International Airspace System |
| IOE | Initial Operating Experience |
| IRS | Inertial Reference System |
| IRU | Inertial Reference Unit |
| JAA | Joint Aviation Authority |
| JAR AWO | Joint Aviation Regulations – All Weather Operations |
| KRM | [Type of Landing system used in certain foreign States] |
| LAAS | Local Area Augmentation System |
| LAD | Local Area Differential |
| LAHSO | Land And Hold Short Operation |
| LDA | Localizer Descent Aid [approach type] |
| LLM | Lower Landing Minima |
| LMM | Compass Locator Middle Marker |
| LLTV | Low Light Level TV |
| LNAV | Lateral Navigation |
| LOC | [ILS] Localizer |
| LOE | Line operational evaluation |
| LOFT | Line oriented flight training |
| LOM | Compass Locator Outer Marker |
| LOS | Line oriented simulation |
| MAP | Mode Annunciator Panel |
| MAP | Missed Approach Point |
| MAS | Missed Approach Segment |
| MASPS | Minimum Aviation System Performance Standards |
| MB | Marker Beacon |
| MCP | Mode Control Panel |
| MDA | Minimum Descent Altitude |
| MDA(H) | Minimum Descent Altitude(Height) |

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| MDH | Minimum Descent Height - NOTE: MDH is not used for US Operations |
| MEH | Minimum Engage Height |
| MEL | Minimum Equipment List |
| METAR | ICAO Routine Aviation Weather Report |
| MLS | Microwave Landing System |
| MM | Middle Marker |
| MMEL | Master Minimum Equipment List |
| MMR | Multi-mode Receiver |
| MOT | Ministry of Transport |
| MRB | Maintenance Review Board |
| MSL | Mean Sea Level [altitude reference datum] |
| MUH | Minimum Use Height |
| MVA | Minimum Vectoring Altitude |
| NA | Not Authorized or Not Applicable |
| NAS | National Airspace System |
| NAVAID | Navigational Aid |
| ND | Navigation Display |
| NDB | Navigation Data Base |
| NDB | Non-directional Beacon |
| NOTAM | Notice to Airman |
| NRS | National Resource Specialist |
| OCA | Obstacle Clearance Altitude |
| OCH | Obstacle Clearance Height |
| OCL | Obstacle Clearance Limit |
| OIS | Obstacle Identification Surface |
| OM | Outer Marker |
| OSAP | Offshore Standard Approach Procedure |
| PAI | Principal Avionics Inspector |
| PAR | Precision Approach Radar |
| PC/PT | Proficiency Check/Proficiency Training |
| PF | Pilot Flying |
| PFC | Porous Friction Coarse [runway surface] |
| PIC | Pilot in Command |
| PIREP | Pilot Weather Report |
| PNF | Pilot Not Flying |
| POC | Proof of Concept |

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|---|---|
| POI | Principal Operations Inspector |
| PMI | Principal Maintenance Inspector |
| PRD | Progressive Re-Dispatch |
| PRM | Precision Radar Monitor |
| PTS | Practical Test Standard |
| QFE | Altimeter Setting referenced to airport field elevation |
| QNE | Altimeter Setting referenced to standard pressure (1013.2HPa or 29.92") |
| QNH | Altimeter Setting referenced to airport ambient local pressure |
| QRH | Quick Reference Handbook |
| RA | Radio Altitude or Radar Altimeter |
| RAIL | Runway Alignment Indicator Light System |
| RCLM | Runway Center Line Markings |
| RCP | Required Communication Perforance |
| RDMI | Radio Direction Magnetic Indicator |
| RDP | Runway Datum Point |
| REIL | Runway End Identification Lights |
| RII | Required Inspection Item |
| RMI | Radio Magnetic Indicator |
| RMP | Required Monitoring Performance (e.g., surveillance) |
| RMS | Root-mean-square |
| RNAV | Area Navigation |
| RNP | Required Navigation Performance |
| RNPx2 | RNP Containment Limit (2 times RNP value) |
| RSP | Required System Performance (Considers RNP, RCP, and RMP) |
| RTCA | Radio Technical Commission for Aeronautics |
| RTS | Return to Service |
| RTO | Rejected Takeoff |
| RVR | Runway Visual Range |
| RVV | Runway Visibility Value |
| RWS | Runway Segment |
| RWY | Runway |
| SA | Selective Availability |
| SARPS | ICAO Standards and Recommended Practices |
| SBAS | Space Based Augmentation System |
| SDF | Simplified Directional Facility |
| SFL | Sequence Flasher Lights |

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| SIAP | Standard Instrument Approach Procedure |
| SID | Standard Instrument Departure |
| SLA | Standard Landing Aid |
| SLF | Supervised Line Flying |
| SMGC | Surface Movement Guidance Control |
| SMGCP | Surface Movement and Guidance Plan |
| SMGCS | Surface Movement Guidance Control System |
| STAR | Standard Terminal Arrival Route |
| STC | Supplemental Type Certificate |
| STOL | Short Takeoff and Landing |
| SRE | [Type of Landing system used in certain foreign States] |
| SV | Space Vehicle |
| TACAN | Tactical Air Navigation system [navaid] |
| TAF | Terminal Aviation Forecast |
| TC | Type Certificate |
| TDZ | Touchdown Zone |
| TERPS | [U.S.] Standard for Terminal Instrument Procedures |
| TLS | Target Level of Safety |
| TOGA | Takeoff or Go-Around [FGS Mode] |
| TSE | Total system error |
| ua | micro amps |
| VASI | Visual Approach Slope Indicator |
| VDP | Visual Descent Point |
| VFR | Visual Flight Rules |
| VHF | Very High Frequency |
| VIS | Visibility |
| VOR | VHF Omni-directional Radio Range |
| VORTAC | Co-located VOR and TACAN |
| VMC | Visual Meteorological Conditions |
| VNAV | Vertical Navigation |
| $V_1$ | Takeoff Decision Speed |
| $V_{ef}$ | Engine Failure Speed |
| $V_{failure}$ | Speed at which a failure occurs |
| $V_{lof}$ | Liftoff Speed |
| $V_{mcg}$ | Ground Minimum Control Speed |
| WAAS | Wide area augmentation system |

| | |
|---|---|
| WAD | Wide Area Differential |
| WAT | Weight, Altitude and Temperature |
| WGS | World Geological Survey |
| WGS-84 | World Geological Survey - 1984 |
| WP | Waypoint |
| xLS | [Generic term used to denote any one or more of the following Navaids: ILS, MLS, or GLS] |